TROPICAL AGRICULTURE

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THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE, ST. AUGUSTINE, TRINIDAD.

GRADING.

THE present century has witnessed a remarkable development in the methods of marketing raw produce, due in large measure to the additional facilities afforded by improved means of transport on sea and land, the extended use of cables and telephonic communication and the introduction of wireless telegraphy. Markets for the main commercial products have lost their limited and localised characteristics and have become world wide. Coupled with an increase in the average purchasing power of the individual there has developed a discrimination in favour of the better quality products. To meet this enlightened demand, scientific control is rapidly replacing rule of thumb methods in the factory. Manufacturers in their turn are demanding from the producers increasing quantities of high and consistent quality produce. In some of the more highly organised industries this demand has already been met by efficient grading but in other industries much remains to be done. Different commodities present varying degrees of difficulty in grading; with some the grades can be determined with great accuracy by a simple mechanical or chemical test; with others, even in the most highly organised industries, commodities cannot be subjected to any reasonably accurate method of grading. Yet in every industry of importance, even in those in which the market is not, and cannot be, highly organised, there is growing appreciation of the necessity for grading, since it is realised that the sale of any ungraded commodity is bound, in the long run, to work to the advantage of the buyer, since he is in a better position to judge of the true value of an ungraded commodity than the individual and isolated producer.

The superior economy of purchasing by grade and reputation is recognised not only in the organised produce markets but also in the retailing or distributing trade. There is a growing tendency to market commodities of all kinds in standardised packages by which the retailer is transformed into a mere agent for distributing supplies according to the demands of the individual purchasers who are relieved of the necessity of becoming expert judges of all the commodities they buy. In many cases standardisation reduces the cost of getting the commodities from producer to consumer, and the earlier the stage at which this grading takes place, the greater is the reduction in the cost of marketing, since every inspection at a change of hands involves additional expense which is passed on to the ultimate consumer. Unfortunately grading frequently takes place at a stage too late to affect the prime producer who, in consequence, receives a depressed price for his produce. Within recent years there has been a distinct tendency for grading to take place at the point of production in order that the producer may secure that share of the ultimate price which is otherwise distributed among the various middlemen. In the case of Californian oranges [1], which are graded and standardised as soon as plucked, the cost of getting from producer to consumer is little more than the actual transport charges, whereas previously the handling charges, now eliminated, formed a

(1) See *Tropical Agriculture* Vol. II. No. 10. p. 235.

considerable item in the price to the consumer. Similar examples are to be found in cotton, coffee, and a number of other commodities, in which systematic grading is consistently practised.

Admitting the desirability of establishing standardised grades the question arises as to the authority which should be responsible for instituting and maintaining these grades. There is, *prima facie*, a case for Governmental interference, it being argued that as the Government fixes the standards of weights and measures and currency, it might logically proceed a step further and guarantee the quality of the commodities produced within its authority. In some countries this principle is accepted but in most cases the state confines itself to protecting the public against the grosser acts of fraud and adulteration. In some cases grading is an extremely simple matter, but with the majority of commodities this is not so, and it would be extremely difficult and dangerous for the State to fix grades which did not evolve in the normal course of business operations. The difficulties accompanying Governmental interference in grading are intensified when the main markets for the particular commodity concerned lie outside the jurisdiction of the grading authority. Even so it is sometimes desirable or even essential that grading should be undertaken by the Government. Such is the case, for example, where the economic organisation of the country is of such a primitive nature that the industry is incapable of fixing and adhering to its own standards. Similarly in the case of federal Governments in which the individual local authorities may fix standards bearing the same name but representing different qualities, it is desirable for the central authority to intervene. Other circumstances might be cited, as for example, when the stability of the country is threatened by the malpractice of individual citizens. Apart from such exceptional situations it is, we think, an accepted principle of British administration that the Government should interfere as little as possible with the conduct of an industry.

The problem of grading has recently assumed considerable importance in the cacao industry. The fixing of a Standard Grade by the New York Cocoa Exchange, under which Standard Growths, comprising Accras of the main crop, Bahia, and San Thomé Fine may be tendered, will have the effect of encouraging grading and standardisation in the countries concerned.(1) In Bahia Governmental supervision in marketing will come into force as from January 1st, 1926.(2) For other growths the premiums and deductions have been fixed at such a margin that in normal circumstances they will not be tendered in fulfilment of a contract. The Exchange is not, therefore, expected to have any appreciable effect upon the marketing of cacaos other than those included in the Standard Grade. In those countries producing a type of cacao superior to the Standard Grade of the New York Cocoa Exchange it is felt that insufficient premiums are being realised for the superior qualities which they represent. Attention was drawn by Mr. J. Forbes, Manager of the Trinidad Cocoa Planters' Association, at a meeting of the Trinidad Chamber of Commerce, to the necessity for establishing standard grades under which the exportation of mixed quality cacaos would not be permitted. The President of the Chamber nominated a Committee representing the various interests concerned for the purpose of co-operating with a similar body appointed by the Agricultural Society in an attempt to devise some method by which the good name of Trinidad Cacao may be enhanced in the world's cacao markets. In the best interest of the producers it is essential that grading should take place on the plantation or estate since merchants will not be able to do so efficiently, if at all, during the height of the season and the natural consequence would be that the ungraded cacao could only be placed in the market as ordinary cacao. Since the planter will derive most benefit from grading it is both fortunate and desirable that the remedy should lie in his hands. We wish the movement every success and suggest that similar movements might with advantage be initiated in other British Colonies and in other commodities.

(1) See *Tropical Agriculture* Vol. II. No. 11. p. 242.
(2) Do. do. do. 248.

COLLEGE NEWS.

The present issue completes Volume II of *Tropical Agriculture*. The Editor desires to thank contributors, honorary correspondents, advertisers and subscribers for their assistance in making the year one of rapid development.

The index to Volume II is in course of preparation and will be circulated with the January issue (Volume III, No. 1) of *Tropical Agriculture*.

A new cover design will be used in Volume III to replace that used in Volumes I and II.

The Colonial Bank has kindly consented to collect Bankers' orders free of charge for subscriptions to *Tropical Agriculture*. Blank forms will be circulated to subscribers whose subscriptions fall due. These forms will enable subscribers to avoid the inconvenience of purchasing money or postal orders for small denominations.

Professor and Mrs. H. A. Ballou returned from vacational leave on Saturday, November 7th by the s.s. *Orange Nassau*.

The Hon. R. Popham Lobb, C.M.G., until recently Colonial Secretary of British Guiana and Colonial Secretary Designate of Cyprus visited the College and was shown over the Buildings and grounds by the Principal.

The Hon. Hector Josephs from Jamaica, while *en route* to take up the post of Attorney-General of British Guiana, to which he has recently been appointed, called at the College and discussed matters with the Principal relating to the future development of the College.

Mr. Gustas Schapt Sommer, Chairman of the Martineau Sugar Company, London, visited the College and inspected the attached Model and Instructional Sugar College.

FUNGUS PESTS.

The Work of the Imperial Bureau of Mycology.

BY SIR ARTHUR E. SHIPLEY, G.B.E., F.R.S.
Chairman of the Governing Body of the College.

This is the foul fiend Flibbertigibbet . . . . . he mildews the white wheat, and hurts the poor creature earth.

King Lear, Act III., Scene IV.

ALL animals are ultimately dependent on plants, for plants build up the foodstuffs necessary for the life of animals. Hence anything that interferes with the life of plants ultimately reacts on the animals. The two great enemies of plants are insects and fungi. We dealt a few weeks ago with the efforts this country is making to control the insect pests of the Empire. The Imperial Bureau of Entomology, which grapples with injurious insects, has its counterpart in the Imperial Bureau of Mycology, a younger organization, but equally effective in helping to control the fungus pests of our Colonies. Under the able direction of Dr. E. J. Butler the Bureau was inaugurated in 1920, and, like the parallel institution, it is financed by contributions from the various Colonies whose troubles it seeks to solve.

Fungi are those plants which are colourless; they have no green chlorophyl within them, and it is this green substance which enables the higher plants to build up, under the influence of sunlight, the starches and sugars which ultimately form our food. Having no chlorophyl, fungi cannot use the energy of the sun, hence they have to adopt another method of life. They either live as parasites on other living plants or animals or they live on decaying matter. In either case they derive their energy by breaking up highly complex substances and, when these are broken up in the living plant, the living plant suffers. Many fungi, such as the bacteria, are microscopic, quite invisible to the naked eye; others, however, form visible growths; from moulds and mildews to the mushroom they increase in size and conspicuousness.

But we must be just even to a fungus. All fungi are not bad. Many of them perform useful and even beneficent functions. Yeast, for instance, converts sugary solutions into alcohol. Yeasts are everywhere and the various vintage wines are, to some extent, due to the particular yeast which is found amongst the grapes. Other fungi (bacteria) help one to digest. The flavour of butter and cheese and tobacco is dependent on bacteria, and they take a large part in the preparation of flax, hemp, and indigo. In fact, we cannot get on without them, though in many cases we cannot get on with them, for they are one of the most potent causes of disease. But on the whole fungi do more harm than good and the work of combating them, which is part of the work of the Bureau of Mycology, is of the utmost importance.

At the beginning of this century there was, I understand, one Government plant pathologist in the whole of our far-flung Empire over-sea; now there are nearly 100 of these medical officers of plant diseases scattered throughout the Colonies and Commonwealths. In old, settled countries the plant and its enemies have come to a sort of understanding with one another. The host has in Lankester's term become "tolerant" of the parasite, but the introduction of new plants into new areas is almost always followed by severe outbreaks of fungoid disease. In Australia, for instance, nearly all the economic plants are exotics; introduced into new lands they meet new pests and the old pests are frequently introduced with them, or find their way in afterwards. In its new conditions of soil, climate, &c., the plant becomes unsettled and falls an easy prey to its enemies. The great rubber plantations in the Malay States suffer from fungi which existed in the East before the rubber was brought there from the Amazon by way of Kew. Rubber left most of its indigenous enemies behind in the Amazon and acquired new ones in the East. In one respect rubber is in happy case, for it has few diseases that are carried by its seed. Cotton, on the other hand, has carried its diseases with it, for they are frequently seed-borne. An instance of this is the bacterium which causes "black arm" in the Sudan, which is seriously threatening the crops there, and is as yet but incompletely understood. Being seed-borne, this disease is apt to turn up wherever cotton is introduced, but fortunately it has not always found conditions favourable for its growth. Since the middle of the last century the world has been ransacked for plants of economic value, and they are being carried about wherever there is a demand for them. The numerous botanic gardens and agricultural departments which now exists are another cause of the dispersion by human agency of plants; but with the plants go their diseases, and in the last 75 years troubles which were once localized have become world-wide. Strict quarantine is now applied to plants. It is far more difficult to get a plant into the United States than a case of whisky.

It is to cope with these enemies and the ever-growing distribution of disease that the Imperial Bureau has been started. It serves two purposes:—(1) It acts as a clearing house for information on every aspect of plant pathology other than those which are connected with the harm caused by animal agencies; and (2) it examines, identifies, and reports on specimens sent to Kew from all parts of the Empire. Keeping in touch as it does with plant diseases throughout the world it is enabled in many cases to suggest effective preventive measures and to forestall trouble. Through the numerous plant pathologists it attempts to make regional surveys of the parasites and their allies. It disseminates information by means of the *Review of Applied Mycology*. This is a monthly journal with a remarkable index, which is of the utmost value to workers all over the world.

It has been known for a long time that the rust of wheat lives part of its life on the barberry and part of its life on the wheat. When the barberry is exterminated the rust cannot live, and rust has been completely eliminated in Denmark by the removal of the last-named plant, whereas in South Wales, where the barberry occurs extensively, the disease in 1919 caused a loss of 50 per cent. of the crop in many places. A similar alternation of rust occurs in the "blister" rust. This fungus passes part of its life on the black currant or other species of *Ribes*, and part of its life on the valuable pine trees of British Columbia and the North-Western States. It was only introduced into America some 15 or 20 years ago, but it has taken firm hold of the country and many of the States have passed laws for the compulsory eradication of all dangerous species of *Ribes*. Without these currant bushes the fungus cannot exist and cannot pass on to the pine. By a self-sacrificing ordinance the American Nurserymen's Association have decided at a recent meeting to "outlaw" the black currant and all its relatives in order to save the trees; but, after all, the self-sacrifice is not so very great, for it is a curious and interesting fact that one seldom sees currants or gooseberries on the other side of the Atlantic.

The whole subject is immensely important. Rubber in Malaya, tea in Indian and Ceylon, cocoa in the West Indies and in the Gold Coast, cotton, rice, and oil seeds in India, wheat and fruit in Canada and Australia, all represent interests of the greatest magnitude and of the utmost importance to the prosperity of the producing country. To give a few statistics: the enormous loss of value caused by plant diseases due to fungi is shown in the following table, taken from the plant-disease survey of the United States in 1919:—

The diseases destroyed amongst the five leading cereals, 482,695,000 bushels.

Potatoes lost, 86,997,000 bushels.

Sweet potatoes, 58,841,000 bushels, more than half the crop.

The United States could have doubled its supply of oats to the Allies in 1917 had it not been for the losses caused by "oat smut"—an easily preventible disease. These fungoid diseases spread from plant to plant through a corn area with incredible quickness, as Hamlet says of his deplorable uncle, "like a mildewed ear, blasting his wholesome brother." In 1916 Canada lost about 100,000,000 bushels of grain of one kind and another, worth between £25,000,000 and £50,000,000.

Owing to a fungoid disease Ceylon coffee fell off from 850,000 cwt. in 1870 to 176,000 cwt. in 1884. The loss on wheat in India is put at £3,000,000 per annum, whilst in Bombay alone the loss due to smut of sorghum, a staple food grain, amounts to £2,000,000 a year. This, however, is fortunately seed-borne and can now be arrested by steeping the seeds in a solution of copper sulphate, and complete protection has been established at a cost of less than 1d. an acre. The citrus canker, which affects the citrus fruit of South Africa, was probably introduced from Japan 20 years since. Eight years ago attempts were made to control it, and in the intervening 7 years, and at a cost of £117,000, the eradication has been successfully achieved. The last case was seen over 3 years ago, although it has recently turned up again when oranges were planted on infected land. This shows that the disease can remain at least for 6 years in the soil after the removal of the infected trees.

Dealing with sick plants is a much more difficult matter than with sick persons. You cannot look at their tongue, or feel their pulse, or listen to their heart and lungs; you can't thump them about and say, "Do you feel anything here?"—but you can take their temperature, and, although this was only first done 2 or 3 years ago, taking it showed that oranges and lemons suffering from fungoid disease had risen in temperature by 1½ degree to 2 degrees F. It is quite natural that it should be so, for the presence of infective germs produces fever. The oxidation is increased.

One of the most devastating diseases is that known as the Panama banana disease. Eighteen months ago I travelled over miles of derelict land in Costa Rica which was once bearing flourishing banana plantations. In Panama one saw the same thing; in a few years 15,000 to 20,000 acres had been abandoned. The capital loss in 5 years was estimated at $2,000,000, and the plantations are now waste ground. Infected land retains the spores of the infective fungi for a very long time; even a period of 10 or 20 years with no bananas growing on it does not free the ground. This Panama disease is established in the Canary Islands, and is said to have been recently discovered in the Gold Coast. Should it establish itself in Africa, as it has done in Central America, the outlook is very gloomy.

One has no space to dwell upon the ever-increasing library of the Institution, the card catalogue of reference, the collections of accurately named fungi, and the provision made to facilitate the work of oversea workers when in England. But one branch of study alone is lacking: the Bureau has no expert on the many fungi that attack man and other animals, but there is some hope that this recondite subject may soon be taken up.

The success of the Bureau has been due to three causes. One is the cordial co-operation of the Colonial Office, whose staff have taken great interest in the work and fully appreciate its value. This has been aided and abetted by a committee, consisting for the most part of experts, who periodically meet and give their services, as so much scientific service is given, for nothing. But the chief factor in the success of the Institution is the great ability and high organizing power of the Director, backed up by the willing work of a small but very efficient staff—*The Times*.

COTTON IN BRITISH GUIANA.

Indigenous Varieties.

BY THE LATE MR. HILLHOUSE.

[*The following extract constitutes an article by the late Mr. Hillhouse who proceeded to the interior of British Guiana in* 1828-29. *This is taken from a work on British Guiana by the late Revd. Robert Duff, M.A., which was published in* 1863.]

IN 1828-29 I proceeded to the interior, and collected seeds of the following varieties, hitherto unknown to our cotton cultivators :—

1. Aoyuama, 2. Comacka, 3. Comacka-Seero, 4. Iffetackaasery, 5. Ebeeseboora, 6. Coodebeyoey, 7. Etoory, 8. Steygur, 9. Cooreeteca, 10. Murry-murry-sereo, 11. The Hard Comacka, and 12. The Silver Seed—being nearly the whole of the indigenous varieties.

SPECIFICATION.

1. Procumbent or Aoyuama—The leaf is an indented pentagon, with the angles at the base, rounded, five-lobed, three glands, four inches in diameter—and smooth beneath.

Stem hairy, with small black spots, on a reddish ground—verticle stem about two feet high—lateral stems proceeding from the verticle, and the root procumbent. Six or eight feet in length average height, one and a half feet, average diameter of the bush or shrub, sixteen feet.

Flowers in January, again in July, small crop in February and March, second, or large crop, in August, September, and November, pod, three to four-lobed, about the size of a pullet's egg, a pointed oval, in all forty dwt. gross weight, the seeds weigh thirty dwt. and the wool ten dwt. net.

Each tree when full grown, will produce from three to three and a half pounds of net wool, which is little liable to blast.

The seed is rougher and smaller, but otherwise very similar to the Sea Island. The staple is, however, much finer and better, and of such astonishing strength and durability, that no known cotton can be compared to it.

It is a hardy plant, bears at five months old, requires no trimming ; and little weeding, covering the ground so completely that but little grass can grow under it. The cultivation and crop may be carried on exclusively by children of eight years old.

Its comparative value at least is fifty per cent. above our ordinary produce and its crop fully double.

It is the opinion of these Indians, who have had opportunities of comparing the two kinds, that it is the parent or original of the Sea Island, in which I fully coincide, the short time in which it bears, qualifying it as an annual, still to be productive in more northern latitudes.

The seeds are downy, light brown, oval, pointed apex, one-third of an inch long, eight in a flake, or lobed generally thirty-four in a pod of four lobes, wool, the lightest coloured of all those known in the market as yellow cottons, flower, pale yellow.

2. The Greater Comacka—The leaf is nearly nine inches in diameter, five-lobed, lobes broad, ending in long semi-voluted points, three glands, under side very slightly furred.

Stem perfectly smooth, with a reddish stripe on green ground vertical stem, eleven feet high, laterals about five feet high, alternated, spreading, and the flowers in single rows, to the extremity, about ten in number on each flowering branch.

Flower large, of a bright yellow, pod large, and pointed with three lobes or flakes, each containing from ten to fourteen seeds say thirty-six in each pod.

The flakes, when expanded, are seven inches long, of a very bright buff hue, three flakes are in a pod, weight 104 grains, namely, 65 grains the seed and 39 grains net wool, a greater net return than of any other kind.

Its crops are in February, March, August, and September, being rather earlier than other cottons. It does not bear so freely as the Aoyuama, but one pod of the Comacka weighs nearly four of the former, and only takes one-fourth the labour of picking.

It has more the appearance of the very finest Merino wool than of any other cotton now in the market, and for the manufacture of nankeens salempores, or the most strong and durable articles, it is most peculiarly appropriate, being almost imperishable with ordinary care.

It bears with the Indian double the price of any other from its great durability and the little labour in picking and spinning it. It is within the knowledge of every old colonist, that an Indian hammock of this material will outlast four or five of the best European manufacture.

It is a cotton that cannot be naturalised in more northern latitudes and appears confined to a more limited portion of the Torrid Zone—the immediate vicinity of the line.

3. The Comacka Seero, or Lesser Comacka—The leaf five-lobed, and equal in size to the Comacka the points of the lobes incurvated downwards. The perfect leaves have only one gland, the under side much more downy than the Comacka, the flowers less regular, but the shrub in every other respect very similar.

The pod is also three-lobed, not so large as the Comacka nor expanding in the same proportion ; it is less pointed at the apex, lobe with only seven seeds—twenty are in the pod. Its crops are in the same seasons as the former kind bearing in a similar proportion. It appears, however, to suffer more from the blast. Its fibre is much finer than that of the Comacka, but it adheres very firmly to the seed, which, when separated from the wool is covered with a down of a pale cinnamon colour.

It is a beautiful cotton, much whiter than the Comacka and though less durable, is much more so than any of our cultivated varieties.

4. Iffetackaasery—Large brown, hard seed, leaf five-lobed seven inches in diameter, downy beneath and of a soft velvet texture above glands varying from one to three shrub, not differing otherwise in appearance from the two kinds before described, the blossom being also a bright straw yellow.

Pod remarkably pointed, with three lobes, each lobe containing two rows of four seeds each and are at the apex, all firmly joined at the base, twenty-seven seeds in a perfect pod.

This is a white and smooth-seeded cotton, in appearance not unlike the hard seed cotton of the coast, but the seeds are larger, of lighter colour, more firmly adhering and the wool lies upon them in a dense body, expanding very little in comparison with other cottons, in exposure to sun and air or drying.

This variety is supposed to degenerate into the Ecooreetoca. I cannot avouch this as a certainty from my own experience, but I am afraid it may be found so, though there is a most marked distinction between the two, both in leaf, pod and seed, as will appear hereafter.

This is a fine, white, long, and silky fibre very durable easily prepared and in every respect a most desirable material for the market. It is supposed that by planting lobes whole, and not separating the adhering seed it preserves its original character, which is a great point to be attended to in its cultivation.

My plans are not sufficiently advanced to give any general idea of its crop, but it thrives equally with any other variety on the coast, and appears to be a good bearer. A supplementary article will be required for this variety.

5. Ebeeseboora or Elbesoboora—Leaf, five-lobed, six inches in diameter, both sides smooth with down, one gland shrub robust and spreading but not procumbent, blossoms frequently of a pale straw colour approaching to white.

Pod a narrow oval, three-lobed eight seeds in each lobe or twenty-four in a perfect pod, seed black with two projecting points at the apex, one-sixteenth of an inch long, oval the upper or narrow half being smooth and the base with a small tuft of brown down. This is a strong, good coloured cotton, easily ginned, a good bearer of a good staple, and very adhesive. It is in appearance very like the coast loose seed cotton, but its fibre is not so silky, though its durability is fully double. Its seeds being large, plump and tough, it must gin with remarkable facility which will be a great argument in favour of its cultivation.

6. Coodebeyoey or Bird's Eye—Leaf, five-lobed, seven inches broad smooth above, slightly downy beneath, with three glands. Pod three-lobed, with seven or eight seeds in each lobe, slightly adhering in pairs, twenty-one or twenty-four in a pod. Seeds one-third of an inch long, an irregular oval, one side being flat ended. Pointed apex, covered with green down, one-twelfth of an inch long, being the root of the woolly fibre, and inseparable from the seed.

This is in appearance a beautiful cotton, being silky and fine, of a beautiful long staple, and yielding a good net return. I have found it, however, very liable to blast when its immediate neighbour, the Aoyuama, was perfectly healthy. It is stronger than the coast cotton, but has no great pretensions to durability in comparison with the varieties before described. An inferior variety of this cotton is cultivated in America, under the denomination of green seed, the seeds of which are smaller oval, and unconnected. I should think that this cotton, worked up with Nos. 1 and 2 would make a most beautiful and durable fabric.

7. Cooreeteca or Ecooreeteca—It is only necessary to mention this variety, on account of its supposed origin from the Iffetackaasery, but which I can hardly reconcile with probability. The Iffetackaasery has a downy leaf, this is a perfectly smooth one; the first only one gland, the second three—the first a close seed cotton, this is very loose seed, small, and taking its name from its similarity to the excrement of a rat, the former is a fine quality in every respect, the latter indifferent in all respects.

I have now accomplished my task in laying before the public the result of my enquiries and experiments, by which, at least, six unknown varieties of the cotton are introduced to the notice of the cotton planters of these colonies. In this number I am assured of having more than one successful competitor, with the finest production of the whole world, now known in the markets of Europe.

COTTON CROPS.

IN its eighth cotton report issued on October 8th, the Crop Reporting Board of the United States Department of Agriculture estimates a total production of 14,759,000 equivalent 500-pound bales. Production was 13,618,751 equivalent 500-pound bales in 1924, 10,139,671 in 1923, 9,762,069 in 1922, 7,953,641 in 1921, and 13,439,603 in 1920, the average production of the five years being 10,982,047. *The Times Trade and Engineering Supplement* states that the yield of Egyptian cotton also is likely to be far greater than usual. Consumers of Egyptian cotton are, however, being hampered at present by the wide difference in price between that staple and the American staple. Between Middling American and fully good fair Sakellaridis on the spot the difference is no less than 15*d.* per lb. A normal difference would be 6*d.* or 7*d.* per lb. There is hope that before long some approach to the normal will be experienced, though rumours have been current during the past few days that the Egyptian Government may come to the support of the market in the event of serious weakness developing. It can, however, scarcely be to the benefit of the Egyptian cotton-growing industry in the long run to keep values on an artificial basis, since it is bound to restrict consumption.

MYCOLOGICAL NOTES.

Soil Transmission of a Grass Mosaic.

EVIDENCE of transmission of the infectious mosaic disease of sugar-cane, maize, sorghum and a number of other grasses, by the soil has been negative hitherto and none of the infectious mosaics of other plants is known to, be definitely retained in and transmitted by the soil. In *Bulletin* No. 1361 of the United States Department of Agriculture, however, H. H. McKinney in summarising the results of his own and his collaborators observations on a mosaic disease of winter wheat extending over a period of six years, brings forward strong evidence that this disease is soil borne and that the soil may retain the power to infect for six years at least. These findings are of interest to those acquainted with the mosaic of sugar-cane because the author considers the symptoms on winter wheats as identical with the symptoms on cane, maize, &c. The disease is as yet known only on winter wheat in Illinois and Indiana and on winter rye in Illinois and the Arlington Farm, Virginia. The disease manifests itself as a mottling of the foliage in dark and light green and pale yellow patches and streaks, and in addition by a marked stunting and excessive tillering resulting in a rosette-like growth. Complete failure of the crop or much delayed ripening may result. There is no evidence of transmission by the seed and the symptoms do not appear until after the spring growth commences. Spring wheats do not become infected.

The first experiment suggesting infection from the soil, was made in 1920, in the infected area. Soil was taken from a field where mosaic was widespread and put into large iron pots in which it was thoroughly disinfected with formaldehyde solution ; after five weeks, seed of Harvest Queen a highly susceptible variety which shows both mottling and rosetting, was sown in autumn in both the treated and the untreated pots. In spring 92 per cent. of the plants in the untreated soil developed mottling and rosette while all plants in the disinfected soil kept healthy, although the wheat in the field where the pots were placed showed almost total infection. In two further experiments small plots of the soil *in situ* were disinfected with formaldehyde and sown in autumn with the same variety of wheat. In the spring all the plants in the treated areas remained healthy, while the plants on the adjacent untreated land showed a high proportion of mottling and rosette. Soil from the infected land in Illinois and Indiana was taken into another State where the disease was unknown and placed in three plots one of which was steam sterilised ; a fourth plot contained unsterilised local soil. The plots were sown in autumn with Harvest Queen and in spring 95 and 50 per cent. of the plants in the untreated introduced soils showed mosaic and rosette while the wheat in the steam treated and the local soil remained healthy. This experiment was repeated in the two following years and yielded similar results.

It might be objected that the treatment of the soil with formaldehyde and steam eliminated some deleterious factor which was not necessarily of a parasitic or an infectious nature. An attempt was made therefore, to transmit the disease by pricking juice from diseased plants into healthy seedlings by means of needles, a sufficient number of controls being similarly treated with juice from healthy plants.

The juice was from a variety (Currell), which develops mottling, but not rosette, and the inoculation was done both on it and on Harvest Queen. A rather low proportion of the seedlings became infected, the best results being 13 infections out of 32 plants inoculated in one series and 5 out of 13 in another series. Both mosaic and rosette, however, developed in some of the inoculated Harvest Queen plants while all the controls remained healthy.

It was also observed that the tissues of mosaic diseased wheat plants invariably showed intracellular bodies very similar to those found in the mosaics of maize, sugar-cane and some other monocotyledons and that such bodies were never present in healthy plants. No evidence of transmission by aerial agencies (insects), was detected either in the field or in the course of the experiments, but a systematic attempt was apparently not made to transmit infection by means of insects infesting wheat. The conclusion reached is that the mosaic of winter wheat and winter rye is an infectious disease of the virus type normally transmitted by the soil which may harbour the infectious agent for a number of years.

It is not known whether any soil inhabiting animal which injures or punctures the underground part of the young plant plays an essential role in giving entrance to the infectious agent nor is it known whether infection occurs in the autumn and remains latent until active growth of the plant is resumed in spring. Although most varieties of winter wheat are susceptible to infection any are tolerant and few develop rosette.

It is of interest to note that a strain of the very susceptible Harvest Queen has been selected which has so far proved highly resistant.

S. F. A.

REFERENCE.

McKinney, H. H. A mosaic disease of winter wheat and winter rye.
Department Bulletin 1361 (1925).
United States Department of Agriculture.

Copies of *Tropical Agriculture* Vol. I, Nos. 5, 8 and 9 and Vol. II, Nos. 1, 2, 3 and 4 are no longer available. A list is being kept of all readers desiring copies of these numbers and is being dealt with in rotation, as additional copies are returned. The Editor requests the co-operation of readers possessing spare copies, in order that other readers may complete their files.

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MANUAL WORK IN THE TROPICS.

W. R. DUNLOP, formerly Professor of Economics at the Imperial College of Tropical Agriculture, contributes an article—based on investigations carried out in Trinidad—to the *Journal of the National Institute of Industrial Psychology*. The studies were conducted with a view to demonstrating the scope for certain lines of industrial psychological investigation in tropical and sub-tropical countries. In the first experiment six East Indian labourers were set to fork parallel strips of land 18 feet wide. Each labourer agreed to do two tasks of 18 feet by 40 feet at 45 cents (1*s.* 10½*d.*) per task, this rate being 5 cents (2½*d.*) per task above the usual rate, in order to induce the men to do two tasks instead of one. Work began at 7 a.m., continued until 11 a.m. and was resumed at 12.15. The work done by each individual was recorded at intervals of a quarter of an hour. Only one man, the oldest, completed the two tasks; the others gave up or had to be dismissed for merely dawdling between 1 and 3 p.m. At the end of the second task this man complained of fatigue and refused to begin a third task in spite of the offer of an increased rate of pay. The work curves bring out clearly the differences in individual capacity. The most interesting feature, common to nearly all these curves, is the fact that the output was greatest between 8.45 a.m. and 9 a.m., the explanation offered being that after that hour the men began to feel first the heat of the day.

The second experiment was carried out in connection with cacao-potting in which the usual practice is for each boy to work independently on a task basis at the rate of 25 cents (1*s.* 0½*d.*) for 250 completed pots. The day's task usually occupies about 3 hours, so that completed pots are turned out at the rate of 83 per hour for three hours. In the experiment the work was divided between two boys, the first selected the sections of hollow bamboo stems with solid joints from the heap, de-budded them with a chopper, made a hole at the base with an iron spike, and introduced a few stones for "drainage," while the second boy filled the pots with earth and planted the seed of cacao. Work was carried on from 7 a.m. to 11 a.m. and from 12 noon to 4 p.m., a period of eight hours. In all the first boy produced 1,819 prepared pots, and the second boy 1,902 finished pots. The main result of the experiment showed that the average output per boy per hour for an eight-hour day was 116 completed pots, compared with the usual average output per boy per hour, for a three-hour day, of only 83. This means an increased output per boy per hour of nearly 40 per cent. and no undue fatigue was apparent or complained of either, during or at the end of the experiment.

A third study in connection with the tapping of rubber showed that in respect of the order and method in which the individual trees in the day's task are selected, there appeared to be more common sense used by some tappers than by others. For instance, one woman, on being questioned, stated that she tapped the best trees first; this is interesting, first, because it is sound, and secondly, because it indicates that she remembered which were good trees and which were not. The soundness lies in the fact that if she tapped the best trees last, they might delay her from finishing her task, for usually (though not always) the best yielding trees flow longest. Many tappers obviously moved about with no particular method and suggested that there may be scope for vocational selection or guidance in regard to tappers, and for motion study in regard to tree-to-tree movement in the fields.

Observations made in the cutting of sugar-cane showed that there is a connection between the type or variety of cane, and the race and physique of the labourers. Uba cane is usually cut by East Indians. This type of cane has a very dense habit of growth, is thin, and its leaves and trash cut the hands and face. Its harvesting, while not requiring great physical strength, does demand great patience and fortitude. The East Indian is more suited for this work than the West Indian (negro), who is better at handling larger and stouter types of cane, like the Demerara seedling, each of which needs strength to handle, but little else. Labourers on Trinidad sugar estates are permitted to eat cane during harvest work. The advisability of this from a physiological standpoint would seem worthy of investigation. The custom affords some little relaxation and nutriment, but the sweetness of the juice may cause abnormal thirst. The use of sodium acid phosphate to reduce fatigue under certain conditions appears deserving of consideration. It is interesting to note that Professor K. Neville Moss, in an article published in the *West India Committee Circular* (January 15th, 1925) showed that experiments in coal mines proved that an increased dose of salt greatly increased the capacity of miners for hard work.

These brief preliminary studies are interesting not so much on account of their intrinsic value as for the indications they offer of the possible application of the principles of industrial psychology to tropical labour. Investigations of this nature have received but scant attention in the tropics mainly owing to the comparative cheapness of labour and partly owing to the conservatism of the labourers. In those tropical countries where the supply of labour is insufficient to meet the demand the application of studies such as these would be well worthy of attention. The problem is bound up with the larger question of the attitude of the labourer towards life in general, for while he is content to earn only sufficient to satisfy the bare needs of existence little progress can be expected. When he shows a desire for, and a willingness to work for, a better standard of living, much can be accomplished in the application of scientific principles to manual work in the tropics. It is becoming increasingly evident that the development of the tropics will come about not because, but in spite, of the cheapness of labour.

AGRICULTURAL NOTES.

COMPILED BY THE COLLEGE DEPARTMENT OF AGRICULTURE.

The effect of grass on fruit trees.

THIS problem, of so great importance to all connected with permanent crop agriculture, has been investigated by Howard under Indian conditions and who confirms many of the results obtained in Europe and the United States. This summary is compiled from an article in the *Agricultural Journal* of India.

Observations were carried out on eight species of fruit trees : plum, peach, custard apple, guava, mango, litchi, sour lime, loquat. Two years after planting (1916) a strip about the middle of the plot comprising nine trees of each of the eight species was laid down to grass—a pure culture of *Cynodon dactylon*, Pers., generally known as Devil's Grass or Bahama Grass, a common noxious weed in the tropics. Another strip was grassed in 1921 to ascertain the effect on established trees. In addition, comparative studies of plots under grass with aeration trenches and under clean cultivation have been made.

Of the young trees, the custard apple proved the most sensitive, trees being killed within two years after grass was planted ; next in order of susceptibility were the loquat, plum and lime, all of which were killed. Only four species seemed able to survive—the peach, litchi, mango and guava, the last being particularly resistant. Except in the guava, the effect of grass covering on the superficial system is to restrict greatly the total amount of root development, to force the roots downwards below the grass and to reduce very markedly the number of active rootlets during the period of rains compared with the enormous production of absorbing roots under clean cultivation. In the case of established trees which have reached their full development the harmful effects of grass were less marked than in young trees, but the order of susceptibility was much the same.

On the whole the general results obtained with clean cultivation, grass and grass with aeration, when compared, point to (1) the deleterious effect of grass on young trees ; (2) the less harmful effect of the same treatment on mature trees ; (3) partial recovery resulting from aeration trenches, notably in the case of the loquat, mango and litchi ; (4) failure of aeration trenches to save plums, limes and custard apples ; (5) the remarkable resistance displayed to grass cover by the guava.

The causes of the harmful effect were also investigated and the more important conclusions were that (1) grass produces a soil atmosphere too rich in carbon dioxide for proper surface root development ; in trying to escape this gas, roots tend to grow downwards and are thereby deprived of sufficient oxygen ; (2) grass reduces the amount of available nitrogen present and there is slow starvation both from lack of oxygen and combined nitrogen, especially during the rains, when the grass develops rapidly. The resistance of the guava to these conditions has already been noted and probably explains why, in the West Indies, it is able to persist on pastures and abandoned agricultural lands.

From observations on forest trees, it was found that their active surface roots could usually compete successfully with grass for oxygen and minerals, at the same time resisting the harmful effects of an atmosphere rich in carbon dioxide, although species vary greatly in this respect. Further, their deep root system enables forest trees to utilize moisture and food materials down to at least 20 feet, thus extending the period of assimilation.

Mountain agriculture.

THE following note taken from *Science News*, Supplement to *Science*, the official organ of the American Association for the Advancement of Science, is published as showing the value of soil conservation measures on steep hillsides. It should be of interest to agriculturists generally :—

" American mechanical genius is beginning to revolutionize mountain agriculture. In the last twenty years the art of rice-growing has been taken out of the hands of the Asiatics and adapted to machine methods so successfully that our high-priced workers now produce the crop as cheaply as the eight-cent-a-day Chinese coolie. But this is nothing compared with the changes being wrought in the handling of hillsides down south.

For years the Appalachian slopes have been washing away with terrific losses to the farmer, because men of western European stock applied the tricks of flat-land farming to the steeps. They had never heard of the terraces and water holes which the Corsican mountaineer, the Javan farmer and the persistent Japanese make to hold the rains and the rich earth on slopes as sharp as a house roof. When news of these methods first came to the American, he was unwilling to use them because of the vast amount of heavy labour required to build such dirt architecture. But, after a while, he began wondering whether machines couldn't turn the trick. And, surely enough, machines would.

A retired engineer, Lawrence Lee, of Leesburg, Virginia, seems to have been the first to hit on a way of using tractors and a specially designed scraper for such work. Even in the heaviest thunderstorms of summer, hardly a drop of water runs off the sixty acres which Mr. Lee now has terraced and planted as orchard. Some parts of this tract have a pitch of about forty degrees—which is quite as great as most of the remarkable mountainside terraces in the Philippines and Java, where for centuries the banking of soil and care of crops have all been done by the most laborious of handwork.

In the last few years progressive farmers in North and South Carolina have adopted this new technique. Especially in the badly eroded stretches along the Catawba River, thousands

of acres have been delivered from the ravages of the rains. Applied to the millions of acres in Appalachia which are being washed away, this method will conserve many hundred million dollars' worth of top soil; and it will convert what is now an unprofitable wilderness into a rich empire. Land worth nothing to-day can, in a few seasons, be transformed into forage crop acreage worth at least thirty dollars per acre; and, after ten or fifteen years of tree planting along the terrace ridges, this same land, as had already been demonstrated in Virginia, yields a return that makes it worth from seventy-five to two hundred dollars per acre.

Professor J. Russell Smith, the economic geographer at Columbia University, has made a special study of the Old World terrace methods and of these new American ways. He has found rough mountain sides in Corsica yielding nut crops as heavily as Illinois bottom lands yield corn. He states that a new dividend-paying country about the size of France will be added to the United States as soon as the Appalachian region adopts generally the tractor-built terraces of the Lee type and develops fast-growing hardwood trees to plant on the land.

That oaks, walnuts and hickories can grow much faster than the common run of them now do is quite as certain as the improvements which have been wrought in corn, wheat, apples and many other crops. Were it possible to increase, by selective breeding, the rate of wood growth by only twenty or twenty-five per cent., this would eventually add many millions of dollars to our national wealth."

Citrus bud selection.

BUD variation appears to be a characteristic of many varieties of citrus. Studies carried out in California since 1909 on the Washington Navel orange have served to emphasize the importance of careful bud selection in propagation work. In an article by Shamel, Pomeroy and Caryl, appearing in a recent number of the *Journal of Heredity*, an account is given of progeny tests of dry limb variations in this variety. Illustrations are given of defective fruits from individual plants propagated from these so-called dry limbs and which retain the undesirable qualities of the original limbs. Many of these fruits are characterised by thick, coarse rinds, little or no juice and light weight—all of which may be perpetuated by the use of bud-wood chosen indiscriminately. Attention is called to this matter in view of the efforts being made at the present time to encourage fruit growing in the tropics, for export. The defects noted above have been frequently observed in the Washington Navel orange but there is a tendency on the part of growers to regard them as due to differences in soil and treatment. Careful study has shown, however, that even known good trees may have one or more limbs producing off-type fruit. Such limbs should be removed when discovered and every care taken not to perpetuate their strains, if reputation for a high-class, uniform product is to be fostered and maintained.

Two remarkable pig litters.

THE *Breeders' Gazette*, Chicago, announces new record weights for a single litter of pigs at six months of age.

Two litters of pure-bred Poland-China pigs raised on the same farm in Illinois, from the same sire, and numbering 16 and 15 pigs respectively tipped the scales in the former case at 4,789 lb. and in the latter at 4,511½ lb.—an average of approximately 300 lb. for each individual pig at six months of age. The previous record was held by a Kentucky litter of 12 pigs of the same breed, their weight at six months being 4,323 lb. It is stated that more than 6 tons of feed were eaten by each of the two litters in question, calculated on a dry basis. The feed consisted of ear and shelled corn, meal, tankage, mineral, kitchen waste and skim-milk. The meal included ground corn, bran, linseed meal, beef-scraps, middlings and gluten feed while the mineral was composed of salt and charcoal. In addition each litter had access to ⅛ acre of rape pasture. The average daily gain of all the animals was practically the same—1·66 lb. for the 16-pig litter and 1·67 lb. for the 15. The former consumed 3·2 lb. of feed for each pound of gain while the latter required 3·22 lb. for each pound gained.

These results, in the first place, mark the Poland-China as a breed in which thriftiness and early maturity appear to be strong characteristics; secondly, they demonstrate the value of intelligent breeding, selection for type, and efficient management in economic pork production.

Tobacco: Points for the grower.

Rate of seeding.

1 ounce of tobacco seed contains 300,000 seeds.

Do. do. equals 10 level teaspoonfuls.

Do. do. is sown to 100 square yards of seed bed, *i.e.*, 10 beds of 1 yard by 10 yards each.

1 level teaspoonful tobacco seed for a bed of 10 square yards.

Planting out.

Placed 2 ft. by 3 ft., one acre would require 7,500 plants.

Placed 3 ft. by 3 ft., one acre would require 5,000 plants.

Approximate yield from a good stand.

Bright tobacco: About 6 plants will yield 1 lb. of dry leaf.

Dark tobacco: About 3 plants will yield 1 lb. of dry leaf.

Type of tobacco produced.

Other conditions being equal, bright tobacco is produced on light soils, with light manuring; heavy tobacco is produced on heavy soils, with heavy manuring.

Size of shedding required.

About 1 square foot of floor-space for every 3–4 plants, for each story or tier in shed.—(*Journal of the Dept. of Agriculture*, South Africa.)

GROUND-NUTS IN THE GAMBIA.

Tropical Agriculture has on several occasions, commented upon the great economic importance of the "strange farmer" to the agricultural prosperity of the Gambia. In the valuable Report of the Department of Agriculture for the year 1924 (obtainable from the Crown Agents for the Colonies, 4, Millbank, London, S.W., price 5*s.*), the Director of Agriculture, Mr. A. J. Brooks, draws special attention to this "annual invasion" of cultivators. "Their presence," he reports, "make [s] all the difference between a good or a bad year, both in respect to the crop of ground-nuts grown, and to the general trade in cotton piece goods. It is upon the sales of cotton piece goods rather than upon the ground-nuts grown, that the trade of the Colony depends." From the chart which accompanies the report it would appear that for some years the number of immigrant farmers varied according to the local price paid for ground-nuts. Thus in 1914 the price paid was 2*s.* 1*d.* per bushel of 28 lb. at wharf towns, this being the highest price paid in the Colony for ground-nuts up to that year, with the result that no less than 32,220 strange farmers came into the Colony the following ground-nut season (1915); an increase of 17,312 on the previous year. With this abnormal influx of farmers a record crop of 96,151 tons was produced, an increase of 29,266 tons over the previous year. Unfortunately the record crop was accompanied by a record low price, varying between 4½*d.* and 7½*d.* per bushel, followed by a falling off of 22,905 strange farmers in the following season. Up to 1919 the local price appears to have governed the situation but from 1920 this ceased to be the dominating factor, and a steady decline then set in and has continued to date.

Mr. Brooks estimates the average output of each strange farmer at one ton per man, and the area cultivated by him at from 1 to 2½ acres. Although it is considered undesirable to offer special inducements to attract immigrant farmers from neighbouring territories, the Director urges that, in view of the importance of the immigrant to the country, nothing should be done to discourage him or to give him the impression that he is not wanted. Among other burdens is included the 4*s.* tax levied upon him at the outset, and the fact that he is usually given the worst land to clean and plant, so that it may be in a better condition for the landowner to plant his corn later on. Seed and food are usually provided, but in return for these the farmer is expected to hand over a portion of his crop to his landlord. It is a significant fact that the introduction of Produce Inspectors coincided with the commencement in the decline in immigration and in the opinion of Mr. Brooks, this inspection, which was nothing less than open persecution, was one of the primary causes of the decline. In 1920 there were 24,150 strange farmers but by 1924 the number had declined to 14,188. Under the inspection system the farmer was liable to be stopped on his way to market and compelled to unload his donkeys by the wayside in order that his produce might be examined. Experience has proved that it was not the farmers who were the chief offenders in the adulteration of produce, but their less industrious neighbours, the native traders. This class thrived exceedingly by the simple process of making up any shortage in tonnage by the addition of sand, for which the farmer was invariably and unjustly blamed. In 1915 this adulteration reached 17·53 per cent. the average being 4·55 per cent. In 1916, 10·46 per cent. was recorded with an average of 4·66 per cent., and in 1923 adulteration varied between 6 and 11 per cent.

In 1920 "The Adulteration of Produce Ordinance" was introduced and brought about some improvement during the first year of working, but ways and means of evading its penalties were soon discovered by all concerned. Even after the nuts had been inspected, cleaned, and purchased, native dealers were discovered to have increased the tonnage with liberal additions of sand. Finding the Produce Inspection Ordinance ineffective the Director finally recommended that all nuts should be passed through a rotary screen at the time of purchase. Three hundred and forty-seven rotary screens are now operating in Gambia. This system, although involving heavy expenditure at a critical period, and some slight delay at the buying station, is preferred to the previous method of inspection and is proving much more satisfactory in operation. Even so traders are known to adulterate the nuts after screening. Another objectionable practice is the dumping of carefully screened nuts on loose sand, some of which is shovelled into the bags. Many firms have adopted the suggestion of laying down permanent concrete floors, or grass or bamboo mats for the reception of their nuts, but others objected on the ground that two per cent. adulteration was permitted by the European market, and if the nuts were shipped too clean this money would be lost.

One of the greatest obstacles to the improved prosperity of the Colony is the inertia of the natives who cannot be induced to increase their production beyond the degree of actual necessity. Ground-nuts are grown to the exclusion of other crops, solely because they require less effort than other crops, and yield a good profit for the labour expended. The natives welcome the strange farmers because the more that come the less need there is of exertion on their own part.

The most unfortunate feature of the adulteration of the nuts is the effect it must have upon the reputation of the Colony's produce. One wonders whether the difficulty could not be overcome by eliminating many of the superfluous and uncontrolled buying centres by registration, licence, and inspection, and the voluntary, or compulsory, screening and grading of nuts, and sealing of the bags, immediately prior to shipment. Many difficulties immediately present themselves but activities would at least be concentrated where they would, most likely, be effective. Any system to be effective must receive the whole-hearted co-operation of those affected and the present system is at least calculated to stimulate this attitude.—C. Y. SHEPHARD.

TROPICAL WORLD NOTES.

Brazil.

Stocks of Brazilian coffee held abroad are reported to be low and a steady demand is anticipated. The *London Chamber of Commerce Journal* reports that the loss from disease has been less than expected, but the long-continued drought in the coffee region is reported to have diminished the crop in many instances as much as 40 per cent., so that any considerable reduction of price is not to be feared. Cotton exports promise to be larger this year than last. Exports of sugar, on the other hand, have dwindled almost to vanishing point. During the first five months of 1923 over 86,000 tons of sugar was exported while during the corresponding period this year the exportation was only 2,480 tons. The production of sugar has not decreased but it is thought that the greater production of beet sugar in Europe, coupled with a greater internal consumption, has been responsible for the decline in exports.

Uganda.

Earlier in the year various bodies interested in Kenya and Uganda made strong representations to the Colonial Office regarding congestion on the Uganda Railway, particular stress being laid on the difficulty of moving the large cotton crop of the inland Protectorate, and the extent of the damage which it was alleged was being done to cotton consignments while they were being handled by the railway. *The Times Trade and Engineering Supplement* reports that the general manager, Mr. Felling, has recently addressed a lengthy memorandum on the subject to the Colonial Office, in which he strongly objects to the suggestion that the damage to cotton takes place after the crop has been handed over to the railway. He contends that the trouble is largely due to insufficient, and even to complete lack of, storage accommodation at ginneries. He states that at some points cotton is rushed to the railway stations by motor lorries, and as the drivers are paid according to the number of trips made, if they are unable to hand the cotton over to the station officials, they dump it by the side of the road. It is obviously uneconomic for the railway to possess large quantities of railway stock which can only be employed during a limited part of the year, and in order to distribute the traffic more evenly, increased shed accommodation is essential. According to the Chief of Customs at Mombasa, 105,127 centals of cotton were shipped in the first quarter of 1925, against 69,776 centals in the corresponding quarter of 1924. During the second three months of this year 319,952 centals were shipped against 212,188 centals in the second quarter of the previous year. As Mr. Felling remarks this region is suffering from growing pains. The Uganda cotton industry is still in its infancy, and there are financial and other difficulties to be overcome, but while the railway management is engaged in building up an efficient transport system the cotton industry must expect to bear its share of the burden.

The Bahamas.

The Bahamas enjoyed another year of great prosperity during 1924. In 1913-14 the revenue amounted to £100,753 and in 1918-19 had sunk to £81,049. By 1921-22 the revenue had jumped to £470,987, in 1922-23 to £852,573 and 1923-24 had fallen to £553,375. The excess of assets over liabilities amounted to no less than £758,576 in March, 1924, the Public Debt at the same time amounting to £20,219. The total trade during the year showed a decrease of about £1,732,000 on the trade of the preceding year, due almost entirely, says the report (Annual Colonial, No. 1241), in a significant passage, to a falling off in the spirits trade. Of the total imports of £1,584,000, spirits accounted for £624,000, and wines, cordials, liqueurs and malt for a further £68,000. The value of imported foodstuffs amounted to £308,000. Of the total exports to the value of £626,000, local produce totalled £274,000 and re-exports, principally spirits, £352,000. The value of spirits re-exported was less by £1,200,000 than during 1923. Sponging is the principal industry, a large number of small vessels being absorbed in this interesting occupation. Sponges are being planted in several localities, and extensive experiments are being carried out by an expert sent out by the Imperial Government. The exports of sponge in 1924 were valued at £131,618. The cultivation of tomatoes is a comparatively new industry, but already employs a large amount of labour, the exports of raw tomatoes during 1924 amounting to the value of £37,381. Sisal valued at £37,861 was exported. Experiments are now being made with a small portable machine for cleaning the sisal and if successful will, to a certain degree, solve the agricultural problems of the outlying islands.

British Togoland.

In the British Mandated Sphere of Togoland the tribes in the Northern Section differ totally from those in the Southern Section, being more powerfully built and living in an almost nude state, but are less advanced than those in the Southern Section where the Ewe-speaking people predominate. The people are mainly agriculturists but exceptions are found in the Eastern Dagomba District where the people are pastoral as well, and in the Southern Section where a number of tribes carry on the industries of fancy cloth weaving, crude pottery manufacture and mat weaving. Five years ago there were no European enterprises and but little external demand for the agricultural products of Togoland. The activities of the people were practically confined to growing foodstuffs for home consumption. Since then a marked change has taken place and the cocoa and cotton industries are in a flourishing state. The cocoa farms compare unfavourably with those of the Gold Coast and there is room for considerable improvement in the quality of the product. The industry is, however, young and the natives appear to appreciate the advice of the Agricultura

Department. The presence of the cocoa disease known as "Collar Crack" has proved more extensive than at first thought, but the Agricultural Department is actively engaged, with the co-operation of the farmers, in uprooting and destroying the attached trees. The exports of cocoa during the financial year 1923-24 amounted to 3,542 tons valued at £99,588. The production of cotton was stimulated by the high prices prevailing at the beginning of the year. Experiments are being conducted, and with increasing confidence an extension of the industry is anticipated. The exports of raw cotton during 1923-24 amounted to 179 tons valued at £5,000. Small coffee plots exists here and there and encouragement is being given to increase the area under this crop. Tobacco to the value of over £3,000, is annually imported into the country, mainly from America. Experiments in cultivating tobacco have not proved successful, but it is expected that with added experience the country will become largely independent of imports. Coconut palms thrive in many villages in spite of constant neglect and it would appear possible that eventually a copra industry may be established. Among other agricultural exports were 531 tons of palm kernels valued at £6,000, 40,954 gallons of palm oil valued at £3,000, and 36 tons of kola valued at £1,350.

Barbados.

The latest report of the Public Health Inspector, Dr. John Hutson, reveals a state of affairs which is truly amazing in view of the reputation of the Colony as a health resort. In dealing with the epidemic aspect of enteric fever in the island he refers to investigations of his own where persons suffering from the disease endeavoured to cure themselves by "trying home remedies," in the meantime infecting other members of the family and other persons living in the neighbourhood. "Some years ago," he reports, "an epidemic of some 40 cases was definitely traced to a vendor of biscuits in a country village who nursed an enteric fever case and sold biscuits at the same time." No water carriage system of sewerage disposal exists. Every householder has to dispose of the family sewerage at his own expense and in the manner that suits him best. Many of the cesspits are saturated with the sewage of generations and are often offensive. When full, the contents are removed at the expense of the householder in uncovered barrels or other receptacles which are emptied into the sea or thrown out on one of the dumps. The pail closet consisting of a keg, kerosene tin or bucket is emptied into the sea at the places appointed for the purpose with properly constructed jetties, or to various unauthorised places, such as "the river," the nearest open drain, or the nearest part of the foreshore or beach. The average infantile mortality for the last 10 years is 280 per thousand compared with 144 and 87 in Trinidad, and England and Wales, respectively. In 1921 the infantile mortality reached the appalling rate of 401 per thousand. Sir Charles O'Brien, one of the most popular of the island's governors, asked the House of Assembly, shortly before his retirement, to vote £500 to £600 to secure a visit from Major-General Sir Wilfred Beveridge to advise a Commission to be set up to report on the sanitary condition of the Colony.

Nigeria.

(*The following periodic report on the cultivation of rubber in Nigeria has been received from Mr. C. J. Lewin, our honorary correspondent in Nigeria. Previous reports on the cotton and cocoa industries appeared in our issues for June and September respectively.*)

Rubber.—Although parts of Nigeria, notably some districts of the Benin, Warri and Calabar provinces, are eminently suited to the production of rubber, yet the annual exports from this country, varying as they do from about 100 to 500 tons, are practically negligible. The cause of this is not obscure. Rubber is essentially a plantation product and it is no longer possible to acquire land in Nigeria. There are approximately 3,000 acres of Para rubber under European control, but these estates were obtained several years ago, before the present government was in existence. In addition there are about 5,000 acres under Para rubber which are owned by natives, these plantations varying from 2 acres to over 1,000 acres in area. But the output of these native plantations is trifling. No plant sanitation is practised and there is no systematic tapping or scientific coagulation of latex. Apart from these Para plantations there are large numbers of trees of *Funtumia elastica* scattered about Southern Nigeria, some semi-wild, others as communal plantations. Many of these latter were planted as a result of European encouragement several years ago. It was then thought that there was a good prospect for native prepared Funtumia rubber but it has since been realized that this low quality product stands little chance against that of Hevea plantations, under the fluctuating conditions which characterize the Rubber Market. Nevertheless, the effect of recent rubber boom is being felt in the Nigerian bush. There is now a demand for lump and biscuit rubber from Funtumia trees and tapping has recommenced in many districts. The current prices offered for these products vary from 7*d*. to 1*s*. per lb.

Departmental Bulletin.—The Fourth Annual Bulletin of the Nigerian Department of Agriculture is now in the press and will be published at about the same time as these notes appear. It contains several papers on Cotton, dealing chiefly with various aspects of the comparative failure of cotton growing in Southern Nigeria. In addition, there is an article on the fertilization of the Oil Palms and annual reports from the various experiment stations. The bulletin is published at 5*s*. (post free) and is obtainable from the Director of Agriculture.

Nyasaland.

It is pleasing to note that 1924 was one of the most prosperous years in the history of Nyasaland, the total import and export trade amounting to £1,131,711, showing an increase of £244,246 over the previous year and being only £45,934 less than the "boom" year of 1920. Exports exceeded imports for the first time since 1920. Records were established for the production of tobacco and tea, the production of tobacco exceeding 7,000,000 lb. and of tea 1,000,000 lb. Cotton yields were low, owing to the depredation of insect pests, but the figures show an improvement over the previous year, while prices were appreciably higher. The work of the Empire Cotton Growing Corporation and the British Cotton Growing Association in fostering cotton growing among the natives has met with considerable success, the production increasing from 747 tons of seed cotton in 1923 to 1,369 tons in 1924. There is a tendency for Europeans in the Protectorate to regard cotton growing with disfavour but the increase in native production has resulted in an increase in the total production, the native share being 36 per cent. in 1924, 22 per cent. in 1923 and 15 per cent. in 1922. In some districts the natives show a marked disinclination to work on European estates, but the immigration of thousands of aliens, particularly from Portuguese East Africa, has prevented the labour problem from becoming acute. The increased production of tobacco and cotton by the natives is being watched with great interest and may have a far reaching effect on the native attitude towards hired labour. Head porterage is rapidly giving way to mechanical transport. The heavy transport charges to Beira is a great handicap to the development of the Protectorate's resources, but a reduction in rates is unlikely until exports and imports have materially increased. Investigations appear to indicate the presence of coal in commercial quantities in the Lower Shire district. It is thought likely that eventually a surplus will be available for export. The visits of the East African Commission and the Phelp-Stokes Education Commission were greatly appreciated throughout the Protectorate.

The Gold Coast.

The annual Colonial report of the Gold Coast for 1923-24 (No. 1255) contains evidence of very satisfactory progress. The report of cocoa, the principal crop of the Colony, amounted to 197,444 tons, valued at £6,058,233 compared with 176,245 tons valued at £6,445,354 in 1922-23. The amount shipped constituted a record (since exceeded) and was due partly to the extension of the railway system and the construction of feeding roads, and partly to the comparatively excellent yields obtained. The fall in value was due to a decline in price from £36·57 per ton in 1922-23 to £30·68 per ton in 1923-24. The exports of copra show a decline of 25 per cent. which is difficult to account for in view of the increasing interest taken in the crop. The exports of palm oil and kernels and kola nuts show appreciable increases. Exports of rubber have shown a remarkable recovery. In 1921, 102,780 lb. were exported, but in the following year, owing to the unprofitable prices realised, exports dropped to 15,282 lb. During 1923-24 the stimulus of higher prices resulted in a sudden jump to 364,644 lb. The supply of food crops was plentiful throughout the year and there are signs of a considerable increase.

Seychelles.

The annual report of the Department of Agriculture for the year 1924 indicates that the Colony is experiencing a recovery of its former prosperity. The yield of coconuts exceeded that of 1923 by 2 million nuts and there is every indication that the record crop of 31,277,743 obtained in 1924 will be exceeded by the crop of 1925. The export of copra which remained at 3,000 tons for many years, increased in 1924 to 3,815 tons. The vanilla industry has made an astonishing recovery, the exports of vanilla beans rising from 692 kilogs in 1923 to 1,429 kilogs in 1924. Plantations are being developed vigorously all over the archipelago and it is estimated that over 400,000 vines, covering 350 acres, are being grown. Should high prices continue it is anticipated that the acreage will be doubled every year for several years to come. As foreshadowed in our last report on the Colony (Vol. II. No. 4. pp. 82-3) the price of rubber has risen to such an extent that planters are regretting the wholesale destruction of rubber yielding trees. A little less than a ton of Para rubber was exported during the year.

Ecuador.

Owing to higher prices obtained for cacao, coffee and ivory nuts, her three leading products, exports from Ecuador during last year were much higher in value, although their volume was that of an average year. Total shipments were valued at 61,000,000 gold sucres, of which the United States took over 35 per cent., Germany, Spain, France, the Netherlands, Italy, and the United Kingdom being the other principal markets, the share of the last named country being valued at 5,000,000 gold sucres. Much of the trade with Italy was in ivory nuts. There was a notable increase in exports to both Germany and Spain. In addition to the three most important products already mentioned, other prominent items shipped from Ecuador last year were cyanide precipitates (containing principally gold), cotton, straw hats, rice, cotton textiles, rubber, hides, kapok and sugar.—(*The Chamber of Commerce Journal* October 16th, 1925.)

All communications relating to *Tropical Agriculture* should be addressed to the Editor, *Tropical Agriculture*, The Imperial College of Tropical Agriculture, St. Augustine, Trinidad, B.W.I.

THE ISOELECTRIC THEORY.

Its Application to Certain Problems of Crop Products Manufacture, and Soil Fertility.

By PROF. F. HARDY, M.A.

[*This article forms the Fifth Part of a series of articles that have appeared in previous successive issues of this Journal. In Part I (August issue) the Isoelectric Theory was stated and explained, and especial consideration was given to the general problem of precipitation of hydrophilic colloids by added electrolytes. In Part II (September issue) the physical-chemistry of coagulation of rubber latex was described in terms of the isoelectric theory. In Part III (October issue) defecation of sugar-cane juice was similarly considered. In Part IV (November issue), the fermentation of cacao beans was dealt with in its physico-chemical aspects, together with a note on diffusion processes in sugar manufacture. The following section deals with soils.*]

PART V.

II.—APPLICATION OF THE ISOELECTRIC THEORY.—*Continued.*

(*b*)—Reactions in Colloidal Soils.

1—*Improvement of Physical Texture by Flocculation.*

IT has long been known that liming and certain other treatments improve the texture of many clay soils, but, until recently, the exact mechanism of the process has been but vaguely understood. The failure of the earlier attempts satisfactorily to explain the beneficial results of liming was apparently due to two main causes. Firstly, clear distinction was not drawn by soil scientists in the early days between very finely-divided, "suspensoid" granular matter, and gelatinous, truly hydrophilic, "emulsoid" matter. The colloidal component of clay soil was originally supposed to belong entirely to the first class, and it was customary to describe the clay content of a soil merely in terms of particle size. We now know that typical clay owes its peculiar properties mainly to hydrophilic colloids. Secondly, it was not clearly recognized in the early days that agricultural clay soils are usually highly complex systems. We now know that the ultimate particles of clay soils probably possess a graded structure, and consist of more or less crystalline cores merging into hydrated colloidal matter which, when traced outwards, exhibits increasing degree of hydrophily, until it finally becomes indistinguishable from the enveloping water-sheaths that arise when the soil is wetted(1).

The differences in responsiveness towards added electrolytes which different field-types of clay soils exhibit, are now-a-days believed to be mainly due to the extent to which the outer hydrophilic coatings of the clay particles dominate the system, and impress their peculiar properties on the whole. In true clay soils, hydrophilic dominance is supreme. On the other hand, in many very fine silt soils (frequently also termed heavy "clay" soils by agriculturists), it is insignificant, because the total amount of hydrophilic matter present is relatively very small.

The mechanism of flocculation by lime.

Lime (calcium hydroxide) readily flocculates true hydrophilic clay soil, either when in aqueous suspension, or when wet in the field, but it does not flocculate very fine silt. Comber (2) explains the positive result as due to chemical interaction between the hydrophilic colloidal coatings of the clay particles and lime, whereby an insoluble coagulum is produced. If we regard hydrophilic clay colloid as a reactive acidic substance, ionizing in the presence of water to give negatively-charged colloidal anions, we can readily interpret Comber's contention in terms of foregoing considerations (*see* Part I). The hydroxyl-ion of the added lime enhances, to a certain point, the ionization of the colloidal acid; the calcium-ion then actively combines with the colloidal anion and forms an insoluble calcium compound. The mechanism is therefore essentially similar to that which we have already discussed in connection with the precipitation by lime of protein and other components of sugar-cane juice, and of the proteinous protector of caoutchouc particles in rubber latex.

It may be objected that free lime cannot long exist as such in soil, because it readily combines with carbon dioxide, present everywhere, to form calcium bicarbonate and calcium carbonate. Admittedly, carbonation goes on very rapidly in lime that has been spread on the field, but it should be remembered that calcium bicarbonate is prone to hydrolysis, through which it liberates hydroxyl-ion in sufficient amount to confer an alkaline reaction on soil water. Furthermore, calcium carbonate, although itself almost insoluble, is readily transformed into soluble calcium bicarbonate by the action of carbon dioxide.

Extension of Comber's explanation; Lateritic soils.

Comber maintains that the chief hydrophilic component of clay soils is hydrous silica together with hydrous aluminosilicates, which always possess electronegative charges when dispersed in water (3). Whilst this may be true for the majority of temperate soils, it certainly is not true for typical lateritic soils, which are widespread in the tropics. Laterite is the result of intense weathering of many kinds of rock material in hot climates exhibiting marked alternation of wet and dry seasons. The process of lateritization converts aluminosilicate minerals finally into hydrous alumina. Easily-soluble bases, such as potash and lime are rapidly leached away, the soil eventually exhibiting a marked acid reaction. Even silica is removed, or at least becomes segregated into more or less crystalline particles of quartz. Iron oxide usually accompanies alumina in the final product, on which it generally confers a

bright red colour. It may or may not be hydrous; in most cases it probably occurs in laterite as the anhydrous form, because hydrous colloidal iron oxide is particularly prone to irreversible dehydration on "ageing" under such climatic conditions as favour the formation of laterite.

Hydrous alumina.

The characteristic component of lateritic soils, namely, hydrous alumina, appears to be a typical colloidal electrolyte, possessing an isoelectric point at pH 6·5. It is therefore readily precipitated (flocculated) by lime in media more alkaline than pH 6·5, so that suitable liming ought to ameliorate the physical condition of lateritic soils, just as it improves siliceous clay soils. On the other hand (and this is a striking deduction from the isoelectric theory), true lateritic soils should also be precipitated (flocculated) by certain acid *anions*, such as phosphate-ion and silicate-ion, in media more *acid* than its isoelectric point. In other words, the addition of, say, calcium superphosphate or of sodium silicate, should effect similar improvements in the physical texture of acid lateritic clay soils as does high liming. Certain preliminary experiments, undertaken by the writer to test this possibility, have shown that the result mentioned may actually occur. It is intended to pursue the subject further, for it is believed that tropical lateritic soils possess certain features quite different from those exhibited by temperate siliceous soils, and that it is fundamentally unsound to apply results obtained by laboratory and field examination of siliceous soils to the agricultural treatment of laterites. There has been too great a tendency in the past to regard "clay" as a definite chemical substance containing silica, water and alumina in true combination. This conception should now be discarded, for it is becoming increasingly evident that there are many distinct types of clay that differ profoundly in chemical composition, mechanical structure and consequently in physical properties, and that these should be studied separately on their own merits. As Comber indicates (4), there is "really no characterization of clay apart from the relation of clay to water," but even this statement should be extended in accordance with the trend of modern physico-chemical research, which is attempting actually to elucidate the mechanism and significance of this clay-water relationship.

Laterites, Bauxites and Lateritoid clays.

It has been stated above that true lateritic clay consists solely of hydrous alumina whose physico-chemical relationships are apparently precise and simple. Whilst this is theoretically true in the limiting case, there are probably few examples of laterites of such extreme simplicity occurring in nature. Bauxitic laterites approach the ideal type perhaps the most closely, for bauxite may be regarded as almost pure alumina which has completely lost its colloidally-combined water, and has "aged" into a crystalline "hydrated" compound ($Al_2O_3.2H_2O$), in which the elements of water have come to occupy a quite different spatial relationship to the other chemical elements (aluminium and oxygen) of the system.

Lateritoid clays, on the other hand, appear to be widely distributed in the tropics. They occupy vast areas, for example, in Africa (5). They usually possess a red colour, because of the presence in them of more or less hydrous iron oxide. They also apparently contain abundant hydrous alumino-silicates, and even hydrous silica as well. In these respects, therefore, lateritoid clays doubtless represent intermediate stages in the lateritization of rocks. Much remains to be done in their delineation in tropical countries, and special soil-survey work may indeed become a necessary pre-requisite to the opening up of new tropical territory to intensive agriculture, if the benefits of modern soil research are to be fully realized.

Lateritoid clays may indeed be highly complex systems, in which the relatively simple "isoelectric" behaviour of their hydrous alumina component may largely be masked by the behaviour of their other components. Nevertheless, even hydrous alumino-silicates and hydrous silica may be regarded as amphoteric colloids possessing definite isoelectric points. Thus Gordon (6) has recently adduced evidence which shows that hydrous silica exhibits an isoelectric point somewhere between pH 3·6 and 1·2. This relatively high degree of acidity, however, is never reached in productive soils, so that hydrous silica always behaves in soils as a colloidal acid, yielding anions that are amenable to precipitation by certain metal-ions such as calcium-ion. In this respect Comber's assumption concerning the chemical characteristics of temperate clays is doubtless correct.

Hydrous alumino-silicates, in a sense, may be regarded as intermediate between hydrous alumina, and hydrous silica. A whole series of different alumino-silicates are probably produced during rock weathering under different climatic conditions. It would be difficult, if not impossible, to isolate the several specific kinds from weathered débris. Hence it will probably prove an unsurmountable task to analyse the physico-chemical relationships and properties of the natural hydrous alumino-silicates, and of soils containing them. The soil scientist may have to be well content with generalizations deduced from the examination of carefully selected geological types.

Enough has now been written to indicate that a re-opening of the whole subject of the physical-chemistry of soils on the basis of modern theories of colloidal behaviour, in particular, those that stress the significance of the isoelectric conception, may aid in giving greater precision to our existing knowledge of soils and in formulating generalizations that will enable the soil scientist to prescribe, with greater definition, specific soil treatments for specific cases. In the next article of this series, an attempt will be made to extend the conclusions here reached to certain problems

of soil fertility. In view of the fact that our discussions have, in some measure, brought into correlation colloidal substances belonging both to the organic and to the inorganic classes of chemical substances, it may be possible eventually to include soil humus as a related type of hydrophilic colloid in the general theory, for it will doubtless have been noticed that, so far, no consideration has been given to humus as an essential component of productive soil.

REFERENCES.

(1) Comber, "The Flocculation of Soils, II," *Journ. Agric. Sci.*, XI, 6, 1921, p. 450.

(2) Comber, *ibid*, and also, *Trans. Faraday Soc.*, XVII, 1922, p. 349.

(3) Comber, "The Flocculation of Soils, I," *Journ. Agric. Sci.*, X, 4, 1920, p. 425.

(4) Comber, "The Characterization of Clay," *Journ. Soc. Chem. Indus.*, XLI, 5, 1922, p. 77 T.

(5) Shantz and Marbut, "The Vegetation and Soils of Africa," *Amer. Geographical Soc.*, 1923.

(6) Gordon, "Theory of Adsorption and Soil Gals," *Colloid Symposium Monograph*, No. 2, 1925, Ch. XI, p. 121.

(*To be concluded.*)

CHEMICAL NOTES.

Compiled by the Department of Chemistry and Soil Science.

Cyclohexanol, a New Industrial Solvent.

An account was given in the October, 1924, number of this Journal of a liquid substance, furfural, which has recently evolved from the position of a rare compound of mere chemical interest to that of a cheap industrial agent of great usefulness. A similar example is cyclohexanol, which is now being placed on the market by the Riedel-Aktiengesellschaft, of Rosslau, Germany, and by Howards and Sons, Ltd., Ilford, London.

Cyclohexanol is the trade name for hexahydrophenol, a derivative of benzene. Heretofore the difficulties of preparing cyclohexanol synthetically were so great that the product was prohibitively expensive. By the large-scale catalytic hydrogenation of phenol, cyclohexanol can now be produced at low cost. The catalyst used is nickel, an agent that is already extensively employed in the hydrogenation process for converting low-melting point vegetable and animal fats into hard fats that largely comprise lard and butter substitutes.

Cyclohexanol is a liquid, boiling at 160°C. and melting at 16°C. It is an excellent solvent for rubber, celluloid, resins and mineral oils, and a good emulsifying agent for fats, waxes and fatty acids. Its simple esters (formate and acetate) are even better solvents in certain instances, and may be used as substitutes for amyl acetate in the cellulose industries. Cyclohexanol is insoluble in water, but readily dissolves in soap solutions, the resulting mixture possessing very high cleansing powers. This property renders it especially serviceable to the textile trades. Liquid cyclohexanol soaps (Savonade, Texapon, Hydralin, &c.), have already been placed on the market. They give profuse lathers, and are certain to be largely used in the household.

In the paint and varnish industry, cyclohexanol and its esters will doubtless be employed as solvents for siccatives or driers (metallic resinates, oleates, &c.), and for dissolving linoxyn (oxidised linseed oil) which is used in the manufacture of linoleum and enamel-varnishes. Furthermore, cyclohexanol forms the basis of many new plastic materials that may be made into photographic films, insulating supports, buttons, imitation tortoiseshell and wood veneers, and of shoe polishes and floor waxes. Its high lubricating and burning properties are additional qualities, and finally, the fact that cyclohexanol possesses the same disinfecting properties as phenol (carbolic acid) from which it is derived, largely increases its usefulness in industry and in the home.

Molasses as a fertilizer in Mauritius.

THE use of molasses as fertilizer has been gradually spreading in Mauritius sugar-cane cultivation since 1900. Recent experience has been described by Tempany and Giraud (Dept. Agric., Mauritius, Gen. Series Bul. 28. p. 28, 1923), who state that molasses is usually applied to fields carrying, or about to be planted out with, plant canes, but it is also frequently applied to ratoon canes. In the first case, it is poured into the cane holes some weeks before planting, or put into the interlines between the young canes. If applied in immediate contact with growing roots, the molasses is liable to be injurious. The amount applied is usually some 4 tons per acre. The beneficial effect on plant canes are usually observed the same season, but on ratoon canes, the benefit is not shown until the next season, and then extends over 3 or 4 years. When used in a cycle of one crop of plant-canes and five succeeding crops of ratoons, molasses may increase the yield of sugar-cane by as much as 20 tons per acre. Apart from the nutrient elements it introduces into the soil, molasses appears to have at first a partial sterilizing effect, which leads later to enhanced nitrification and nitrate accumulation at the time of greatest need.

Products from Sugar-Cane Megass.

Many large modern sugar factories produce megass in excess of fuel requirements, and several new uses for the surplus have been suggested. Amongst these may be mentioned paper and "celotex." Celotex* is board lumber which is light in weight and highly insulating to heat. It is manufactured by cooking megass to remove wax and resin and to render the cellulose fibres tough and flexible. The fibres are then separated by heating; some waterproofing substance is added, and the material is finally pressed into boards and dried.

* A. G. Wikoff, *Chem. Met. Eng.*, 1923, p. 360.

A TRINIDAD COTTON PEST.

BY C. L. WITHYCOMBE, PH.D., D.I.C.

AMONG the most important pests of cotton in Trinidad are the cotton-stainer bugs of the genus *Dysdercus*, and to these reference has already been made in *Tropical Agriculture* (1). It was noted that stainers bred upon several Malvaceous plants in addition to cotton and that the cotton crop was liable to infection with them from various such outside sources. The insects are particularly attracted to cotton when the bolls are opening and also they are induced to migrate from their other food plants by shortage of food. The wild food shortage usually begins with the dry season, when the cotton crop also often commences, so that stainers may come in enormous numbers to cotton at this time and subsequently.

Unless the numbers of stainers are reduced by hand collecting, trapping, &c. the later pickings of cotton are likely to be of progressively less value as the pests increase in numbers, and it was suggested (1) that the aim should be to secure a good first crop of bolls, after which subsequent pickings should be sacrificed and the cotton plants destroyed completely to prevent further breeding of stainers upon them. A good first crop of bolls could be obtained by attention to time of planting, variety, spacing, &c.

In St. Vincent excellent results have been achieved in reducing the numbers of stainers by the elimination of wild food plants in the island and such a control measure obviously commends itself where practicable.

Trinidad possesses another insect pest of cotton; a moth closely related to the notorious Sudan boll worm (*Diparopsis castanea*). It was first described as *Sacadodes pyralis*, a new genus and species, by H. G. Dyar in 1912 (2), from three specimens sent to him from Trinidad by P. L. Guppy of the Board of Agriculture. Dyar mentioned that the moth had also been captured in Venezuela and Argentina. Since 1912 nothing further appears to have been published concerning it except for a mention by S. C. Harland of the "Trinidad Boll Worm" in a list of Trinidad cotton pests (3). Concerning its habits no information exists, so far as the writer is aware, and the present short note is therefore offered merely as a preliminary outline pending further observations.

Sacadodes pyralis is a Noctuid moth which spans about one and a half inches across the forewings. The latter are clayey to purplish-brown in colour with some not very striking markings upon them. The hindwings are paler.

The moth lays its eggs singly on the leaves, bolls, stems, &c., of the cotton plant, but most commonly at the bases of the bolls where protected by the bracts. The egg is a beautiful object, almost spherical in shape, 0·7 mm. in diameter, and sky-blue in colour when first laid.

The egg-shell shows a fine network sculpturing and it bristles closely with small spines, the points of which are turned, or somewhat hooked. After a few days the colour of the egg becomes greyish and the young larva bites its way out from the egg-shell when about a week has elapsed.

The newly hatched larva or caterpillar is pinkish or madder-white in colour with a large brown head and prothoracic dorsal shield. It makes its way at once to a boll or flower bud and commences to bore into and feed upon the interior. A larva which enters a well-grown boll usually remains for the whole of its life within this, but larvae hatching from eggs laid on stems, leaves or flowers may find insufficient food in the first bolls or flowers which they enter and in consequence of this they move from one to another as the food supply becomes exhausted. Whether flower buds or bolls are attacked the larva usually enters at the basal portion of the flower or boll, covered by the bracts, and bores into the interior. Well grown, mature bolls are most often found attacked, the seeds being destroyed and the lint ruined.

The larva becomes full grown in the course of a few weeks and it then measures just over an inch in length. The head and dorsum of the prothorax are brown or yellowish-brown. The ground colour of the body is creamy-white but on the back there is a suffusion of crimson. The crimson pigment sometimes spreads almost over the entire body of the caterpillar but it is always most intense dorsally. Other larvae are found mainly creamy-white in colour with a mere pink suffusion upon the back. Throughout all its stages the colour of the larva may be described in a general way as pink, and its colour, associated with cotton-feeding habits, is sufficiently characteristic for a rough indentification in Trinidad, until the Pink Boll Worm makes its appearance. The latter is superficially rather similar to a young *Sacadodes pyralis* larva.

The mature larva makes its way out of the cotton boll and down to the ground where it pupates at or near the surface. Sometimes, however, the bracts around the base of the boll are drawn slightly up with a few silk strands and the pupa is found rather insecurely placed beneath these.

The pupa is a shiny, brown or yellowish-brown object, about half an inch or a little more in length. The adult moth escapes from it in from two to four weeks, and the life cycle recommences.

The Trinidad boll worm, so far as present observations go, seems to prefer cotton to other food plants and although the writer has once obtained a larva from sorrel (*Hibiscus sabdarifa*) and once from okra (*Hibiscus esculentus*) fruits, these plants do not appear to be much frequented.

During the greater part of the wet season, possibly correlated with the small number of bolls available, *Sacadodes* larvae are rarely met with. They begin to appear towards the end of October or in November, and from then onwards, especially

in the dry season, do they increase in numbers. The percentage of infected bolls is sometimes high. Perennial cottons are particularly favoured and isolated plants of these with infected bolls numbering from sixty to seventy per cent. have been noted. This refers especially to isolated perennial cotton trees grown in peasant gardens.

The larva of *Sacadodes pyralis* is occasionally parasitised by a Braconid; also, after making its exit from the boll it is liable to attack by at least one species of carnivorous Pentatomid bug, which pierces and sucks the larva, usually just before pupation. Dead larvae have been seen covered by a growth of fungus, but this is believed in most cases to be secondary and the fungus a saprophytic one.

From the small amount of data now available and neglecting for the time being the possibility of control by parasites, also by spraying, &c., it seems that the only certain method of keeping down the numbers of this boll worm is by eliminating outside breeding grounds and by cleaning up the cotton after crop. Of breeding grounds the writer would particularly emphasize the need for attention to perennial cottons, at least during a close season. Other alternative food plants may be found in the course of further investigation. A thorough and detailed study of the insect is required before effective control measures can be initiated. The present notes are based upon discontinuous observations extended over little more than two years.

(1) *Tropical Agriculture*, Vol. I No. 10, 1924, pp. 156-7.
(2) Proc. Entom. Soc. Washington, XIV, 1912, pp, 167-8.
(3) Trinidad as a possible site for a Central Research Station. Report by J. B. Farmer and L. G. Killby. Empire Cotton Growing Corporation. London 1925. p. 41.

PAPAIN.

(Several readers of *Tropical Agriculture* have asked for information concerning the preparation of papain. For the information of those who are interested we have pleasure in publishing the following notes which are taken from a recently published pamphlet on *Minor Industries for the Leeward Islands* by the Hon. A. E. Collens, Superintendent of Agriculture for the Leeward Islands and Mr. F. H. S. Warneford, Assistant Government Chemist of the Leeward Islands.)

Commercial Papain is the dried latex of the fruit *Carica papaya*. It is largely used as an aid to digestion in virtue of the proteolytic ferment contained therein.

At the present time the demand is in excess of the supply which is obtained chiefly from Ceylon with small quantities also from Montserrat. The United States of America is the largest consumer importing annually to the value of £15,000 to £16,000.

Carica papaya is a distinctly tropical plant; specimens grown out of the tropics seldom bear fruit. The plant is best grown below an elevation of 1,200 feet. Once established the trees are capable of enduring a wide range of moisture variations in the soil; but under water-logged conditions they suffer.

For the preparation of papain the latex is collected by making slight incisions not more than one-eighth of an inch deep in well-grown unripe fruit and allowing the resulting milk to run into enamelled or earthenware vessels. Iron and steel should not come in contact with the latex as they discolour it—a sharp piece of glass or a knife made out of a thin shaving of bamboo may be used for incising the fruit.

After collection the latex is treated with water, which instead of diluting it causes it to curdle. The coagulated mass is squeezed in a cloth to remove some of the superfluous moisture and the residue is either spread in a thin layer and sun dried or is dried in an oven at 100 degrees to 120 degrees F., the rate of drying being hastened by the passage of a current of air.

It has been found in India that in the preparation of crude papain, the following points are of importance as influencing the activity of the product:

(1) Dry as quickly as possible—below 40 degrees C.
(2) Complete the drying process in vacuo.
(3) Grind the dried product and ship in sealed bottles or in lead-lined wooden boxes.

The papain industry has been in existence in Montserrat since 1891, but during the past 11 years there has been a gradual decline owing to the superior attractions of cotton.

Recently, however, a few large planters have turned their attention to this industry on systematic lines, and it is to be hoped that there will be a recrudescence of the industry in the near future.

The climatic conditions as indicated above are such that would allow the cultivation of this crop in most of the islands of the colony, and in view of its admittedly profitable nature under Montserrat conditions, the extension of the industry can be recommended.

In conclusion it may be stated that the price paid to peasants in Montserrat for wet milk over the past few years has been 1*s.* 6*d.* per lb. and this figure has been found profitable.

The market value of papain varies from 7*s.* 6*d.* to 15*s.* per lb. depending on the activity of the product. With a return of one lb. of dried papain per 4·4 lb. milk as obtained from one type at the Montserrat Experiment Station there would appear to be a very fair margin of profit when a high class product is put on the market.

The subscription to *Tropical Agriculture* is six shillings per annum, post free, to all countries within the British Empire or seven shillings, post free, to all other countries. Subscriptions can commence at any time during the year.

REVIEWS.

PHOTOSYNTHESIS; the Assimilation of Carbon by Green Plants. WALTER STYLES, SC.D. (Camb.) Longmans Green & Co. VI + 268.

Any book dealing with the subject of photosynthesis must have some appeal to the agriculturist, for it is on this process that agriculture and ultimately the entire present day civilisation depends. The process is, however, extremely complex and not readily described in simple language. The work under review constitutes a very detailed, technical, and up-to-date account of the recent work on the subject, and as such its main appeal will be to the specialist.

H. M. LEAKE.

REPORT on the Cotton Growing Industry of Uganda, Kenya and the Mwanza District of Tanganyika, by COLONEL C. N. FRENCH, Empire Cotton Growing Corporation. 1s. 3d. post free.

This is a report by Col. French of a journey taken by him through these territories. It is a succinct account of the efforts to introduce a crop into a tract distant from the sea, occupied by races little accustomed to agricultural pursuits, and lacking capital. Such are the conditions of practically all the vast tracts of Central Africa where cotton can be grown. In Uganda the development has been phenomenal; twenty years ago the crop was unknown while now it is near the quarter million bale mark. Such a development has necessarily raised questions of transport, seed production and distribution, ginning and last but not least finance. As a study of the way in which these difficulties have been surmounted and a record of the difficulties encountered and of the way in which they have been surmounted, the report forms a valuable guide to those undertaking similar developments elsewhere.

Of the many and important aspects, perhaps the most important is that which concerns the division of the profits. The fact that the period of development covers one of abnormal prices, which is probably the cause of the speed of that development, has emphasized the point. To the expenses of growing are, or should be, debitable a considerable portion of the cost of Government, especially of such charges as maintenance of the lines of transport. For this purpose the Government impose a tax but the adjustment of that tax to accord with fluctuating prices is not an easy matter. In all cases where the human element has a relatively low standard of living a time is soon reached when additional gain does not call forth an equivalent response. Graduation of a tax is theoretically sound, not only in the interests of the community by building up a reserve for development in times of prosperity, but in the interests of the individual whom excessive wealth tends to demoralise. The Uganda Government appear to have been conservative in their estimate of what is legitimate. "The Government policy is to maintain the tax for the present. If prices drop considerably they have stated it may be necessary to reduce the tax or to make it graduated. It is now generally realised that some form of taxation is necessary to enable the Government to meet the expenses of development, and that the existing tax does not press heavily on the natives or on the industry." The point is important, since demoralisation will check development when, as appears to be the case now, the labour supply is deficient.

In Kenya the possibilities for development are not to be compared with those of Uganda and at present it is restricted to the Native Reserve of Kavirondo.

The possibilities of Tanganyika are as yet not fully explored and progress is likely to be slower for the development has come too late to secure the advantages, not unaccompanied by disadvantages, of the sensational post-war boom. The country is, however, feeling its way through the same complex of agricultural and economic problems.

H. M. LEAKE.

THE LEEWARD ISLANDS.

The Hon. A. E. Collens, Superintendent of Agriculture, and Mr. F. H. S. Warneford, Assistant Government Chemist of the Leeward Islands, have recently published a concise and admirable pamphlet entitled, *Minor Industries for the Leeward Islands*. The limitation and practical collapse of the market for Sea Island cotton, aggravated by the appearance of the pink boll worm, have proved a serious blow to all the presidencies of the Colony with the single exception of Dominica, in which the crop is not cultivated. Montserrat and Nevis, where cotton has for some time been a staple, have been particularly affected. The poor market for citrus products has proved a serious danger for Dominica, particularly in view of the presence of the wither-tip disease of limes. Throughout the Colony there is an urgent need for minor industries. The writers suggest that a considerable extension of the area under coconuts, particularly in Dominica, would prove beneficial. Oil palms could be cultivated profitably in Dominica and Montserrat, the manufacturing difficulty being overcome by means of small hand machines. The market for castor seed and its products is practically unlimited and heavy yields are obtainable in the Leeward Islands. Rotation with ground-nuts and sweet potatoes should be practised. Vanilla has been grown on a small scale both in Nevis and in Dominica and would prove a suitable crop for small cultivators with little capital. Ginger is grown in Dominica for local consumption but with greater attention to its preparation might be developed as a crop for export. Among other promising minor industries nutmegs and mace, fruits and vegetables, papain, tobacco, raisin, grapes and bay oil are suggested. Practical hints as to cultivation and preparation for market are given, together with a review of the possible demand for the various products.

THE MARKETING OF CACAO.

Successful Co-operative effort in Trinidad.

PROF. C. Y. SHEPHARD, B.Sc. (Econ.).

CONSIDERABLE interest has recently been raised and maintained in the marketing of cacao, due largely to the unprofitable prices realised during the seasons 1920-24, and the efforts of planters since those periods to organise some machinery for securing more remunerative prices. Planters, on the one hand, maintain that it does not pay to produce superior, well-prepared cacao, since it does not command the premium to which it is entitled, while merchants and manufacturers, on the other hand, claim that they are prepared to pay enhanced prices for good cacao but cannot obtain it in sufficient and continuous quantities. Both claims are entitled to respect. A single planter is not likely to obtain the full premium to which he is entitled for his superior cacao and merchants are unable to pay high prices for small quantities of cacao of which there is no continuity of supply. Much time is spent and expense incurred in proving that it is a superior kind. When planters can guarantee a continuity in the supply of superior cacao they will receive, and the merchants will be willing to pay, higher prices. In this connection the Cocoa Planters' Association of Trinidad, Ltd., forms an interesting and successful example of co-operation among cacao planters for marketing their produce and securing a premium for better grades.

The Association was formed in the latter part of 1905 by the proprietors of 26 cacao estates, the objects being "to grade, bulk, deal with, and dispose of, the produce of the members, as the Committee in their discretion think fit." The original working capital was obtained by a loan from the Colonial Bank, and provision was made for working expenses, such as salaries, wages, rent, &c., by an entrance fee of 10*s.* per member, an annual subscription of 2*s.* 6*d.*, and a charge of 10*c.* (5*d.*) for every 100 lb. of cacao marketed by the Association. In this manner the provision of a large amount of original capital by members was avoided. Only proprietors of cacao estates or planters were eligible for membership, each member on joining giving an estimate of the normal production of his estate and entering into an agreement to market the whole of his produce through the Association. The transaction of business was entrusted to a Committee appointed annually, meetings being held at least once a month, with provision for special meetings when necessary. The other regulations of the Association need not detain us.

The first two years ended with a 'loss' of $2,104.04 (£438 6*s.* 10*d.*) largely owing to the heavy expenses involved in ascertaining market movements by cable. Other contributing factors were the poor crops realised and the strenuous opposition of local cacao merchants, one of whom appears to have been particularly persistent in his efforts to "bear" the market and discredit the Association. Inspite of these discouraging features only one member resigned. The next year's operations, in spite of adverse circumstances, ended with a 'profit' of $233.56 (£48 13*s.* 2*d.*) and a net membership of 23. This year appears to have been a turning point in the history of the Association for, during the following year, a net total of 15 members was added. The Committee decided to set aside the sum of $2,400 (£500), being the estimated 'profit' for the year 1909, in order that advances might be made to planters, who, although willing to become members, were unable to do so without securing an advance upon their growing crop. Interest at the rate of 8 per cent. per annum was to be paid on the advance; a very moderate rate in comparison with usurious rates, aggravated by 'commission,' exacted by unscrupulous money lenders—as contrasted with *bona fide* merchants and other firms—into whose hands the peasant proprietors were prone to fall. A rapid increase in membership followed and the Association was compelled to move to more commodious premises. In 1915 the Association was incorporated as a company limited by guarantee, each member entering into an obligation to pay a sum not exceeding £10 if, on the winding up of the Association, a deficiency was disclosed. The registration fee was increased to $5.00 (£1 0*s.* 10*d.*). A Board of Directors consisting of not less than 4 nor more than 9 Directors, exclusive of the President, who is elected annually, was substituted for the old Committee. The two Senior members of the Board retire annually but become eligible for re-election. The Association at this time consisted of 78 members and dealt with an annual average of about 18,000 bags of cacao.

The war period was an exceedingly difficult one for the Association owing to the absence of adequate shipping facilities. In addition an unfounded allegation that the Association was an enemy alien concern did considerable harm at a most trying period. In 1918 the crop handled by the Association had increased to such an extent that a full-time manager was appointed. In 1921 the sum of $2,716.33 (£565 18*s.* 0½*d.*) was placed to reserve, representing the difference between the amount of 11*c.* (5½*d.*) per fanega (165 lb.) allowed for working expenses and the amount actually expended. By June 30th, 1925, this reserve had been increased to $30,416.97 (£6,336 17*s.* 4½*d*). The members now (November, 1925), number 181 with crops approximating 50,000 bags, or 8,250,000 lb. The Association markets approximately one-seventh of the Colony's total production of cacao and plays a very important part in the marketing of the better grades of the Island's cacao. This, in broad outline, is the history of the Association to date.

Now, it may be asked, what advantages has the Association rendered to its members? The Committee endeavoured to interpret the benefits of the Association into terms of money, and estimated that in the Season 1909-10 the members had

profited to the extent of $16,000 (£3,333 6s. 8d.) in comparison with sales effected outside the Association. While respecting the integrity of the officials of the Association and their industry in collecting these figures, the writer maintains that this estimate is quite erroneous since the true comparison should be between the prices realised through the Association, and those that would have been obtained had the members marketed their crops individually. Since this cannot be ascertained it follows that the advantages attaching to membership of the Association cannot be estimated in terms of money value. Since it is the policy of the Association to refuse admission to those estates known to produce an inferior cacao, and to eliminate those members whose produce falls below the standard aimed at by the Association, it follows that the average quality marketed is higher than the average quality marketed in other ways. Therefore unless the Association does secure higher returns for its members it may be said to have failed in its object; but how great that premium is, or ought to be, it is impossible to estimate with any great degree of accuracy. In passing it may be noted that the earlier reports of the Association refer to the "losses" and "profits" on the year's working. Actually there are no profits—except the revenue arising from the sale of non-members cacao on commission—and no losses, which can be disclosed by the balance sheet. The so-called "losses" and "profits" merely represent the difference between what the members receive and what they were entitled to receive. In other words the "profits" represent that part of the price due to members which the Association decides to place to the credit of individual members as reserve (1), while the "losses" merely mean that more has been paid to the members as price than that to which they were entitled.

It is frequently asserted on behalf of similar Associations, and doubtless, too, of this one, that their value lies in the elimination of the middleman, it being assumed by the over-credulous that that mysterious individual possesses some supernatural power by which he can extract a tribute from industry without rendering anything in return, much in the same way as banks—a particular type of middleman are popularly supposed to be endowed with the peculiar and mysterious faculty of "creating" money. The Association has, in fact, succeeded in eliminating the middleman, but only in so far as it has thought fit to perform itself the services of the middleman. At its inception the Association found it impossible to do without the services of the bank which undertook to provide capital in the shape of a loan, for which service the Association paid by means of interest. A profit arising from the elimination of the middleman can be secured only if additional capital is employed and additional risk incurred, or if the employees of the Association perform their work more efficiently or receive less remuneration. It may be noted that the Directors render their services without fee of any kind so that the Association saves the sum which it would be necessary to expend to secure their services, or the services of some individual or individuals acting in that capacity. The Association has been extremely fortunate in securing on its Directorate men of undoubted ability and wide business experience. For the merchant's profits and losses are substituted the manager's salary. Since merchants frequently employ managers one can legitimately assume that, on the average, the excess of profits over losses is more than sufficient to pay for the services of a manager. This excess is, however, largely in the shape of interest on the capital invested by the merchant and while normally more than the rate of interest charged by the bank on the loan to the Association, the difference cannot on the average be very great. The fact that the Association has paid off this loan or mortgage and has accumulated a considerable reserve does not materially alter the position since, in effect, it means that the members have temporarily foregone a portion of the price due to them and have invested it in the Association.

The net advantages secured by members of the Association under the foregoing heads, while appreciable cannot be considered very large. The main advantage, in the opinion of the writer, lies in the fact that the Association is able to place upon the market a continuous and large supply of good and consistent quality cacao. The quality is maintained by eliminating applicants known to produce inferior cacao and by excluding those members whose cacao consistently falls below the average demanded by the Association. The members' cacao thus already of a fairly uniform quality is examined further for the purpose of eliminating any of inferior quality which may have been tendered by individual members. This is set aside and sold locally and not as the standard produce of the Association. The result is that the standard product of the Association is of a remarkably good and consistent high quality for which manufacturers are prepared to pay a premium. Each and every member has a direct and pecuniary incentive to produce and market good and well-prepared cacao. The individual merchant while ensured of a certain continuity of supply by various means, cannot in the nature of things, expect to receive cacao of the same uniform quality as the Association; indeed much of his profit accrues from his skilful grading and bulking of the various and mixed qualities purchased by him. The individual planter frequently deludes himself with the belief that a small portion of inferior cacao mixed with that of a superior quality will escape unnoticed. He is ignorant of, or ignores, the fact that this small portion of inferior cacao lowers the value of the whole quantity to such an extent that he receives appreciably less than he would have done from the marketing of two quantities of different quality cacao. The reputation which the Association now enjoys has

(1) Interest at the rate of 6 per cent. per annum is paid on such reserves.

been laboriously established and maintained during the twenty years of its existence. This, although it finds no place in the balance sheet, is the most valuable asset of the Association and one of which it is legitimately jealous.

It may be asked why, if the Association confers such substantial benefits upon its members, are its numbers not greater than they are? In attempting to answer this question it should be remembered that the Association *has* increased steadily and is still increasing, and that it is far safer to build slowly and carefully than to jeopardize the reputation of the Association by a sudden influx of new members. The other reasons usually advanced such as the conservatism, distrust and ignorance of planters of the mechanism of the Association, &c., may be dismissed shortly. While appreciable factors they are too indefinite to permit of investigation. Some planters may hold aloof on account of the guarantee of £10 which has to be given, but in view of the healthy financial situation of the Association, this factor cannot carry great weight, if indeed it would under other circumstances. Others of an independent nature prefer to market their own cacao and derive more satisfaction from the few additional cents secured by "haggling" than the time and energy lost would warrant. Many planters are satisfied, and frequently rightly so, with the services offered by the individual merchants, for it must be remembered that in Trinidad they are old established and, in general, very efficient. The personal relationships and mutual confidence which have arisen between planter and merchant are highly valued by both. These planters believe either that the Association has no additional benefits to confer which they are not already enjoying, or that they are too nebulous to warrant a change.

While this disposes of a large number of possible members of the Association, there still remain a considerable number of planters who are unable, even if willing, to join the Association, on account of the fact that they are mortgaged to merchants in the City, and are bound to deliver their produce to these merchants. There is nothing necessarily vicious in this system since the individual planters, either through fortuitous circumstances, or their own inefficiency, improvidence, or neglect, or a combination of all, have become involved in debt, and without some such proviso they would have found it extremely difficult to secure any advance upon their estates. By the loan of capital the merchants have, in a sense, become partners in the estate and for their own security should acquire a deciding voice in the marketing of the produce. It may be added that some merchants would willingly dispose of their mortgages if the planters were able, or others willing, to relieve them of the responsibility. It is highly probable that many of these planters would, if able, become members of the Association. Finally there remain those planters whom the Association would not allow to join, and those who produce so superior a cacao that they would derive little advantage from the Association.

There is one direction in which, in the writer's opinion, the work of the Association might be improved. At present there is no incentive for planters producing the very finest cacao to join the Association since the proceeds of the sales are distributed *pro rata*. Such planters would find an incentive if the Association were to market its produce in standard grades. The present standard is already remarkably uniform and the addition of another grade—"Superior Plantation Cacao C.P.A."—would probably suffice. The proceeds of the sale of this cacao would be distributed *pro rata* among those planters forwarding it to the Association. The establishment of such a grade would also provide an incentive for existing members to pay further attention to the preparation and grading of their cacao, knowing that the additional labour expended would result in a premium for their superior cacao. Intermittent attempts, meeting with indifferent results, have already been made, but they have been too sporadic to permit of definite conclusions being drawn. Considerable time must of necessity elapse before such a grade would secure the full premium to which it is entitled.

Although the Association plays an important part in the marketing of the Colony's cacao, particularly with regard to the better grades, it will be realised that its scope is to some extent limited by existing circumstances. Its work in securing for individual planters the full premium to which they are entitled for their high grade cacao, and the incentive which it provides for producing and preparing good cacao, is of great importance and capable of much wider application. For example the "Trade Mark" principle might be applied to the produce of the Colony as a whole. Manufacturers complain that the quality of Trinidad cacao has steadily deteriorated during the last few years. If planters could be assured of receiving a premium for well prepared cacao there would at least be an incentive, said to be absent now, to pay greater attention to the proper preparation of cacao. For this purpose the grading and sealing of cacao might be carried out either voluntarily or compulsorily immediately prior to shipment.

The mechanism of the Cocoa Planters' Association might be reproduced with advantage in those cacao producing countries where the marketing mechanism is not so efficient as in Trinidad. The Gold Coast immediately appeals as a favourable field. That country, as a cacao producer, has suffered up to the present from a multitude of petty parasitic traders, and the lack of a direct and pecuniary incentive to produce well prepared cacao. Associations might be established at convenient centres and might undertake the preparation of cacao and should certainly provide adequate storing facilities which are usually lacking on the property of the average peasant proprietor. The absence of suitably qualified officials would at first confine the field of such associations to a limited number of well defined areas but facilities would doubtless increase as the benefits of such societies became more apparent.

TREND OF THE MARKETS.

[*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.*]

SUGAR.—Cubes declined to 36*s.* 6*d.* per cent. duty paid on October 4th. Other types showed a tendency to rise towards the end of September, but fell away again during the first two weeks of October. Best Granulated sold at 28*s.* 9*d.* and West Indian Crystallized at 26*s.* 3*d.*, each per cwt. duty paid, on October 14th being in each case the same price as on September 16th. The market is disappointing as the low prices have not proved that stimulus to consumption which was expected. For the first nine months of this year consumption showed an increase of 4½ per cent. over the corresponding period last year, while the quantities placed on the market show an increase of 10 per cent.

COTTON.—As a result of the Bureau report of an indicated crop of 14,759,000 bales, prices have shown a sharp decline but towards the middle of October a steadier tendency was observed. The earlier reports of the Bureau are criticised as being bad under-estimates of the coming crop which promises to be an exceptional one. Opinion is divided as to whether the latest report is still pessimistic and in the absence of reliable guidance the market is nervous and unsettled. After declining to 11·45*d.* per lb. spot on October 12th prices hardened to 11·41*d.* on October 15th.

COCOA.—Prices have remained very steady. During the second week of October, Ceylon Ordinary made 107*s.* 6*d.* and Grenada Fine 67*s.* 9*d.* and Accra Fermented 47*s.* 6*d.*, each per cwt. Trinidad Mid. Red remained 77*s.* 6*d.* on October 14th.

COFFEE is not a brisk market but prices are not discouraging, even Brazilian being a little on the mend for good Santos Since our last report Costa Rica Middling has advanced 6*s.* to 174*s.*, East Indian Mysore Middling 6*s.* to 140*s.* and Kenya after rising 6*s.* to 132*s.* fell later to 130*s.*, each per cwt. on October 14th. Brazil Santos declined 4*s.* to 98*s.* on October 7th but afterwards rose to 10*s.* on October 14th.

TEA.—Tea is selling well and the recovery indicated in our last issue has been well maintained. Averages on October 14th included Ceylon 21·21*d.*, Indian 16·54*d.*, and Java 13·44*d.*, each per lb., showing a rise of 3·31*d.*, 2·04*d.* and 2·15*d.* per lb. respectively over September 16th. London Auctions have this year placed 2,444,000 packages against 2,257,000 packages for last year over the period January 1st to October 10th.

SISAL AND HEMP.—Both Sisal and Hemp have moved slightly in buyers' favour during the month although Hemp shewed some improvement during the second week in October. Prime Sisal realised £45 per ton and Manila Hemp £42 10*s.* on October 14th showing a decline of 10*s.* and £1 10*s.* per ton respectively since September 16th.

RUBBER.—The market has been very active during the past month. The feature has been the interest taken by America in distant deliveries. The Continent, too, has been more active. The shipments from Singapore for the first half of October were 12,857 tons against 11,740 tons for the same time last year, and 12,700 tons during the first half of September. Sheet realised 4*s.* 1½*d.* and Crepe 4*s.* 1*d.* per lb., on October 20th.

COCOA IN BRAZIL.

SINCE our last issue the following information concerning the control of the marketing of cocoa in Bahia has reached us. From January 1st next, the following regulations will be enforced:

1. Four premiums of 50 contos of reis each are offered for the first four warehouses to be built in Bahia during the next three years, exclusively for the storage of cacao beans, with capacity of 50,000 bags each, and properly equipped, in the opinion of experts to be appointed by the Government, for the storage, handling, and prompt shipment of the commodity.

2. The Government will treat with the port corporation for the construction of a warehouse having capacity for at least 180,000 bags, and equipped as above, and in case of construction it shall be declared an official warehouse for exportation, charging rates to be approved by the Government.

3. Two of the warehouses described in 1, or that described in 2, being constructed, the executive power will regulate the purchase, sale, and exportation of cacao beans produce in this state according to the following principles, not excluding those implied by the tenor of this law, the intent of which is to protect the cacao industry and the good fame of its products abroad.

It has been laid down that official types for the exportation of cacao beans shall be those adopted and ruling in the market of New York, viz., "superior," "good fair" ("regular"), which words shall be placed plainly on the sacks; but for cacao beans without any defect, the exporter may add the qualification of "fine" to the title "superior." The exportation of cacao beans inferior in quality to "fair" or "regular" will be permitted only when the bags are conspicuously marked "restolho." The mixture of "superior" cacao with inferior grades shall be prohibited; blending shall be permitted only between different lots of "superior" type in order to render the appearance uniform, and between quantities of the grade "good fair" and "fair" solely or together in order to reduce the percentage of defects.